Innovations in Science Education and Technology

# Web-Teaching

## A Guide to Designing Interactive Teaching for the World Wide Web

SECOND EDITION

David W. Brooks
Diane E. Nolan
and
Susan M. Gallagher

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Second Edition

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# Web-Teaching

## A Guide for Designing Interactive Teaching for the World Wide Web

## Second Edition


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# Preface

When the first edition of Web-Teaching was written, in late 1996, the Web seemed to be emerging as a powerful force in education. The half-decade since has seen remarkable instructional innovation based upon the Web. At the same time, seeking the goose that lays the golden egg, college administrators with little or no technical expertise have driven faculty to create Web courses. Distance education went out; extended education came in. Politicians began to anticipate substantial instructional savings. Thus far, any profits have been minimal and any savings experienced have been small ones.

Web courses and Web-based course supplements have popped up all over all over the world. No central force has yet emerged which dominates the field. Indeed, nearly every college, from the large to the small, has become a player.

Tremendous, broad-based Web-delivery activity has characterized the last few years of the 20th century. Elementary students publish Web-sites. Teachers use Web-pages to communicate with parents.

Web-commerce has flourished. The wave of Web-commerce has paled that of Web-teaching. The infrastructure that is emerging to support Web-commerce ultimately will permit piggybacking of Web-teaching. We can expect fast Web access to be available in students' homes.

We see this edition as continuing to offer helpful, research-based suggestions to teachers who would improve their teaching using the Web. The first edition of Web-Teaching was somewhat dated when it came off the press. This edition also shoots at a quickly moving target. Much has happened in four years. Little has happened, however, to modify the principal messages of the first edition. This edition attempts to focus reader attention on research reported from the early days of Web teaching.

There are six things we can say about Web teaching at this time:

1. Course Management Software (*WebCT, CourseInfo*) has emerged and been embraced strongly by teachers. As a result, the number of teachers whose courses have some Web presence is mushrooming. For our first edition, Web teachers who managed their own servers represented a large fraction of those using the Web. This no longer is so; today few teachers manage their own Web servers.
2. The first edition suggested that Web teaching might not be successful in certain content areas. It turns out that Web teaching can be applied to nearly any non-laboratory course in the curriculum. Even portions of some laboratory and studio courses have been handled well on the Web.
3. While extensive studies are not available, early results suggest that students in Web courses learn about the same amount as do students in traditional courses. Drop out rates in Web-based courses are higher than in traditional courses, but similar to other distance courses.
4. There have been no results that suggest strong learning gains from multimedia approaches to teaching. Thus far, it appears that media have small effects. Active learning approaches have larger positive effects on learning outcomes.
5. Many teachers have developed Web supplements for their courses. There is very strong evidence that the students who use these resources learn better than those who do not.
6. Very few teachers have enjoyed time efficiencies as the result of developing a Web presence. Quite the opposite; teachers find that Web courses take more time. This is especially true of courses involving discussion, where reading Internet-based discussions can become an enormous chore.

A major difference between this edition and the first edition is that this edition was first created on the Web, and then converted to paper. The number of chapters has been increased. Several topics have been included that were missing in the first edition. For example, we devote a chapter to a discussion of Web courseware applications. Courseware helps teachers to organize and deliver courses that are entirely Web-based. We also stress the metacognition of the Web, those core skills that help us know what to do whenever we use the Web as an information gathering or transmitting tool.

David Brooks notes, with great personal regret and sense of loss, the passing of his friends and mentors Frank Collea and Alvah Kilgore. They both were prime movers of the first edition

David W. Brooks
Diane E. Nolan
Susan M. Gallagher
Lincoln, Nebraska
August, 2000

**PREFACE (1st Edition)**

This book deals with using the kinds of hardware, software, and networks commonly used on the World Wide Web (WWW) to deliver and support instruction and learning.

When the opportunity presented itself to write a book on multimedia and science teaching, I took it gladly. I've had an unusual career. I was trained as a chemist by Joe Gettler at New York University and Charles Dawson at Columbia. Even while still a junior at NYU, my interests turned toward chemistry education. By the time I was tenured, I had decided to devote full time to chem ed – against the wise counsel of many friends and colleagues.

My early experiences were based on very large classes and multisection courses with thousands of students. In fact, in my last semester as a chemistry coordinator, I supervised more teaching assistants than students I've ever had in any semester since becoming a full-time Professor of Curriculum and Instruction! With large enrollments in multisection courses, it is not surprising that course coordinators turn toward multimedia. I've worked with multimedia intensively since 1968, my first year as coordinator of a large, multisection course.

After graduate school, I never used computers for much other than recordkeeping. I did use a wonderful and powerful but obscure computer language, APL, to develop some management tools for large multisection chemistry programs. My first introduction to desktop machines came with the early IBMs around 1980. A rapid conversion put me on a path toward Macintosh in early 1988; I was fully converted by June of that year. I can't tell you how much I look forward to a common platform.

My introduction to the World Wide Web came from Paul Kramer who demonstrated Mosaic to a Nebraska faculty group a few years ago. I confess to being impressed and unimpressed at the same time. Everything seemed quite good except for the very slow speed and substantial system instability. Netscape changed that. By late summer of 1995, I had set up my first server. I'd been a "paperless" professor for several years, having switched to 3.5-inch disks a

decade ago. The Web was even better. In addition to text and images, I was able to use the WWW to distribute software from my course pages.

The last thing I thought possible would be for instructional costs to go down – in any subject. WWW instruction seems to be less expensive for institutions than conventional instruction in many areas. Wow! That is a very scary thought.

When asked to write a book that looks ahead into a fast-moving system in transition, I decided to work in two areas. One was to give readers an idea of the nature of the pieces currently available for instructors to play with when delivering Web-based teaching. The other was to try to assemble sufficient resources from teaching and learning research such that those teachers could begin with instructional designs likely to be effective.

Chapter 1 is an introduction that summarizes these views in some detail. Chapter 2 includes potentially useful research on teaching and learning. It may surprise many readers to learn that support for multimedia or learning styles is much weaker than many think it is, but that support for cooperative learning seems very strong.

Chapter 3, "Multimedia Overview ," begins some nuts and bolts about multimedia with a review of the kinds of media available on the WWW. Chapter 4, "Web-Ready Materials," deals with getting materials ready for the WWW. To make the WWW work for you, you need to have some notion about how communications are transacted. It's almost like learning a programming language in terms of how it works and what it does. Chapters 5 ("Images"), 6 ("Movies; Desktop Television Editing"), and 7 ("Other Media") focus on a few details about images, movies, sound, and several other media.

Chapter 8 ("Encouraging Web-Based Discussion") turns the focus back to instruction. It deals with strategies for supporting student-student and student-teacher discussion using the WWW. When I dug into the related literature and looked critically around me on my campus at what was going on, I was surprised at the success teachers have had in using the WWW to stimulate and support student discussion. In an age where one might guess that the first teachers using the Web would be scientists and mathematicians exchanging highly technical information with students, one finds, instead, scientists and mathematicians generating student discussion about the technical information.

Chapter 9 ("Interactive Strategies; Forms") is more of what you might expect of technical information being taught on the Web. It focuses on having students respond to specific, sometimes technical questions in a variety of ways. If there is a unique take-away lesson from Chapter 9, it is that quick and dirty e-mail may be the fastest and easiest way for you to start putting useful interactive Web-based responding mechanisms into your students' hands. Meanwhile, the chapter is full of examples-from simple to complex.

When I moved from chemistry to curriculum and instruction, it was mostly the result of many years of concern about the care of the inmates in the asylum. I believe that teachers do matter. Ms. Le Wand, Ms. Leshinsky, Mr. Miller, Mr.

Tucker, Dr. Joe Gettler, Dr. John Ricci, Dr. Charlie Dawson, and Dr. Gilbert Stork were darned good teachers for me, and they shaped my life in many ways. Frankly, I can't imagine much learning without teachers. But, it is clear as a bell to me that we are going to be asked to teach students using electronic leveraging systems. My preparation for this book has convinced me that this is not necessarily a bad idea for many students. Some students, however, will be lost and others nearly lost from the gitgo. I think we can try to help those who are nearly lost by taking advantage of information developed over the last 20 years in an area known as self-regulation – strategies for developing the will and the skill to learn. That is what Chapter 10 ("Promotion of Self-Regulated Learning") is all about. When I finished the book, I was disappointed that this chapter was short and picture free. I hope that enormous amounts of good research are performed such that, in a later edition of this book, Chapter 10 will grow and improve more than any of the others.

Chapter 11 ("Creating and Managing Web Sites") deals with setting up Web sites. This is a very simple task.

Bandwidth and security will limit the WWW in many ways. Chapter 12 ("Weblets, CD-ROMs") offers two solutions to the problem. One is to create a subset of the WWW (a counterintuitive move considering what the Web is and what it does), and the other is to create CD-ROMs to hold materials, especially movies and large media files. With ROMs I seek to deliver instruction at the learner's machine rather than over a network.

Chapter 13 ("Security Issues; Intranets; Offering Courses for Credit") deals with strategies for security, intranets (networks walled off from the WWW), and some issues related to offering Web-based courses.

Chapter 14 ("Lecturing; Multimedia Classrooms") speaks to lecturing and multimedia classrooms. My view is that converting all of your course materials to WWW formats just with the intent of lecturing is smart. You can have the full multimedia power of the WWW in your classroom. Being able to lecture entirely from Netscape Navigator would be a big improvement over the strategies I've needed to use in years past. There also is some information about multimedia classrooms in this chapter for those interested in developing such rooms for lecturing. Having converted your materials, you also place yourself in a near-ready position to provide direct Web-based student access to those same lecture materials.

That's *Web-Teaching*. I hope you find it useful, interesting, and helpful as you think through the many issues concerned with Web-teaching, be that in a small classroom or throughout the entire electronic world.

David W. Brooks
Lincoln, Nebraska
January 1997

Acknowledgments

This project could not have been completed without the support of our spouses, Helen, Michael, and Brian. The first edition was inspired and nurtured by Frank Collea and Alvah Kilgore, two wonderful teacher-scholars who died since the first edition was published. We miss their friendship, advice, and inspiration.

Charles Ansorge has been tireless in his support of Web teaching development at Nebraska. Kent Crippen provided numerous insights as we developed the manuscript. John Orr has expanded the ways in which faculty can support their students' learning, and has shared these opportunities widely. Gregg Schraw has provided the intellectual underpinnings for much work in Web teaching. Karen Cohen helped us to envision the 2nd edition, and to enhance the value of our efforts for our readers. Emily Haden helped us prepare the manuscript, and put up with a remarkable amount of entropy.

We owe much to the support of others who provided us with information, materials, advice and examples, including Amjad Abuloum, Katherine Ankerson, Leona Barratt, Daniel Bernstein, David Beukelman, Sidney Brown, Roger Bruning, Orville Chapman, Newell Decker, Martin Dickman, Paul Erickson, John Flowers, David Fowler, Calvin Garbin, William Glider, Shelley Haberlan, Elizabeth Hendrickson, Lynne Herr, Christy Horn, Ken Jensen, Todd Jensen, Tom Koch, Gail Latta, Scott Long, John Markwell, Mimi Mann, Christine Ann Marvin, Ali Moeller, Charlie Nolan, David Nolan, Stephen Panarelli, Jim Partridge, Judith Poë, Arlene Russell, Bruce Sandhorst, Dennis Smith, Allen Steckelberg, Sheldon Stick, Bob Tice, Bill Udell, Don Uerling, Pat Wegner, Fred Wendel, David Woodman, and Delivee Wright.

# Contents

# Web-Teaching

## A Guide to Designing Interactive Teaching for the World Wide Web

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# CHAPTER 1

# Introduction

You probably are a teacher either thinking about using the **Web** in your teaching, or a Web teacher looking for new ideas. This book is first about teaching, and then about the Web. Since you already know something about teaching, we thought we'd begin our journey with some information about the Web.

## ABOUT OUR FORMAT

This book was developed as a **hypertext** Web document, and then converted to print. As described in Chapter 6, hypertext permits the user to go directly to different text (or other media) located elsewhere in the same document, or in an entirely different document, perhaps one located on a different **server** – with servers located around the world. In the Web version, underlining indicates hypertext. The Web version makes use of four types of hypertext links. Glossary links are bold-faced. References appear in square brackets, e.g. [reference]; **clicking** the hypertext link displays the reference. Chapters sometimes are linked, and it is possible to move from one chapter of *Web-Teaching* to another. Finally, there are hypertext links to materials that are not a part of this book. These appear underlined, and are followed by curly braces containing the letter U, a chapter number, and another number (example: {U00.00}). Clicking these links will bring up information about the link, the **URL,** and a date on which we tested the link. Access dates are noted because, unlike a traditional print library, the Web is a dynamic resource with materials

continually being added and deleted. All the links were actually accessed a second time during July or August, 2000 to verify their continuance.

In the print version of the book, glossary terms are highlighted in bold the first time they appear. References are listed at the end of each chapter. Both glossary terms and URLs are listed in the back of each chapter and in consolidated lists at the end of the book.

## THE INTERNET – A BRIEF HISTORY

We're sure you've heard about the Web. You may not know much about its origins, however, so here is a brief history.

In 1957, the Soviet Union surprised the world with the launch of the first ever space satellite, **Sputnik.** With the Soviet Union's atomic capabilities, the launch was seen as a military threat. The Soviets were perceived as a world superpower capable of substantial technological, scientific, and military feats, with an apparent lead in technology. In response, President Eisenhower of the USA created the Advanced Research Projects Agency, (ARPA), a military research agency to improve the United States' ability to develop research results quickly and efficiently.

In 1966, Robert Taylor (the man in charge of ARPA's computing operations) grew tired of having to switch computers and passwords to connect to multiple sites, and envisioned a network of interlinked computers. He went to his boss, Charles Herzfeld, and requested funds to create a dynamic communications system. After a brief explanation of a vision of networking all ARPA's computers, with no formal proposal, Herzfeld granted the project a $1,000,000 budget.

Two persons often are identified as "the father of the **Internet.**" The first actual Internet-like connections were developed in Leonard Kleinrock's {U01.01} laboratory at UCLA, and the process made use of a strategy developed in his doctoral dissertation. J. C. R. Licklider {U01.02} of MIT may really have been the Internet's prime mover. His insights shaped the environment that led to much of the networked computing we use today.

Over the next 20 years, first under the auspices of ARPA and later under the National Science Foundation (NSF), a network of computers grew. Intended at first for military purposes, the ARPAnet (now known as the Internet) gained additional **nodes** at educational institutions nationwide. In return for the use of their locations, the universities were allowed to use the network for research and educational purposes. In its early years, the Internet handled text-only communications (**ftp, telnet, e-mail**).

In the early 1970s, universities began to provide electronic "**bulletin boards**" on their time-sharing systems. These bulletin boards provided for an exchange of information campus wide. With the availability of inexpensive

bulletin board software, the use of bulletin boards spread into the community. Some private bulletin boards began to charge a nominal fee for their services.

Around 1972, a new application called USENET was developed to exchange information on a group-to-group basis, rather than a person-to-person basis. USENET was the first "**newsgroup**" application. USENET provided a way to interconnect "bulletin boards" on a store-and-forward system. USENET was a somewhat inefficient method for exchanging information between a large number of sites since, at each stage, each message had to be passed from computer to computer with no central routing. Today USENET is Internet-based.

Federal dollars supported the early years of the Internet. In 1979, CompuServe began offering e-mail services directly to personal computer owners. E-mail became available to almost anyone. Commercial interests grew rapidly. By 1995, the Internet was supported almost entirely by non-Federal sources.

## THE WEB – A VERY BRIEF HISTORY

In 1989, the CERN High Energy Physics Lab proposed developing a system that would permit ready access to many kinds of computer information and link information together. The result was the World Wide Web (WWW, or Web) proposal. A key Web feature was **hyperlinks,** clickable connections between information sources. Tim Berners-Lee, working at CERN (European Organization for Nuclear Research, originally the Conseil Europeen pour la Recherche Nucleaire), developed a system of addressing messages called the uniform resource locator, or URL. Discussed in more detail later, the URL has several parts: a process, how the transfer will be made; an Internet address, unique for each node or computer on the Internet; a "path" to a file; a file name; and a MIME extension, something that indicates the format of the data in the file. Also developed were the hypertext transfer protocol (http), the **hypertext markup language (HTML),** and early versions of server and **browser** software.

Interest in and expansion of the Web awaited the development of suitable software. Working at the University of Illinois, Mark Andreessen was a prime mover in the creation of *Mosaic,* a browser program that transformed the vision of the Web into a practical application. Andreessen together with venture capitalist James H. Clark (founder of Silicon Graphics) founded the Netscape Corporation. *Netscape Navigator*, the second evolution of browser software, was made available to many users without charge! While *Mosaic* provided an insight into the capability of the Web, the real potential of the Web emerged with the first release of *Netscape Navigator* software. In only about a year and a half,

Netscape had some 65 million users. The transformation of the "look and feel" of international communications had begun.

An interesting description of the Web is that it is a new way of publishing, an alternative to books and journals. As such, it will have a drastic impact on teaching around the world. It is clear that the Web is much more than just a publishing alternative. When the first edition of this book was written, the Web was still in its infancy. At this writing, it has reached toddlerhood, but is still growing and expanding exponentially.

***The Web is changing both what we teach and how we teach it.***

## THE ROLE OF COMPUTERS

Today it is clear that essentially everyone in the United States, and billions throughout the world, will use computers in their personal and professional lives. Computers will be our connections to the world of commerce. They will provide access to sources of information. Computers will provide the communications lifeline to family, friends, and business associates.

Try to imagine professional circumstances that do not make use of computers. This is clear in 2000, even before a promised transfer of entertainment from television and cables to computers has made a substantial foothold.


Figure 1.01. Web commerce extends into traditional arenas. An example is ordering groceries over the Internet. Home delivery is just a click or two away in many regions of the United States.

## IMPACTS OF THE NEW TECHNOLOGIES

Digital tools (calculators or computers) change the nature of tasks in a very fundamental way. Norman [1991] devised the term **cognitive artifacts –** creations that change the nature of the task and, therefore, the core skills required for success. Those who learned mathematics before the advent of the handheld calculator can appreciate the increasing complexity of equations which are easily solved by the use of button based functions now available. Teachers and textbook authors no longer need to concern themselves with designing problems which minimize the need to calculate such things as square roots. With the simple push of a button, students can get multidigit accuracy. Hand calculations and books of function tables no longer are needed.

### Graphing Calculators

To illustrate the point, consider graphing calculators that make the creation, display, and analysis of graphs straightforward. The kinds of questions one can ask, as well as the understandings arrived at using graphs, are deeper than those from the pencil and paper solutions or digital calculators of the recent past.

The potential for the deeper understandings has been appreciated for a long, long time. Although either pencil and paper or a calculator can be used to calculate points to be graphed, it can be very tedious to create and interpret even a single graph. Graphing was very time consuming. The graphing calculator tool changed the graphing task. This change brought about a reevaluation of graphing relative to its difficulty. Good graphing calculators cost less than $100. The result is the importance of graphing to practical problem solving has increased. (Figure 1.02).

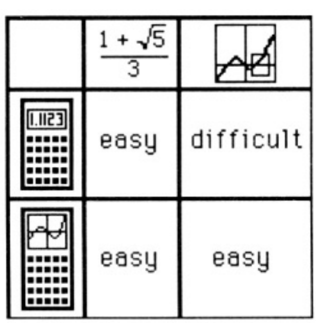


**Figure 1.02. With both ordinary and graphing calculators, calculations of square roots are easy and straightforward. Although possible with an ordinary calculator, a graphing calculator makes analysis of graphical functions much easier. Knowledge of graphing becomes more powerful, and graphical analysis is more likely to be applied in practical situations, such as chemistry "titration" curves.**

## Spreadsheets

Consider the function $f(x) = cx(1\text{-}x)$, and the situation that arises when the result from one calculation is cycled back into the succeeding calculation.

When performed by hand, the calculations are exceedingly tedious, even with a calculator. When a **spreadsheet** is applied to the task, results appear nearly instantaneously. Depending on the value of $c$ and the initial value of $x$, the result after many iterations may be a constant, or become bistable, or even become chaotic. The calculations are simple. Without a spreadsheet, the tedium of the arithmetic would be enormous. Virtually no one born before 1960 either studied this body of mathematics as students, or was aware of the often remarkable results. Demonstration of the phenomenon using a spreadsheet takes seconds – and permits vastly different approaches to the solution of certain real-world problems. Now that the spreadsheet tool is available, something rarely touched on 15 years ago becomes routine – because the tool simplified the task (Figure 1.03).

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Value of c | 0.800000 | 1.500000 | 3.100000 | 3.500000 | 3.900000 |
| 2 | Initial Value of x | 0.100000 | 0.100000 | 0.100000 | 0.100000 | 0.100000 |
| 3 | 1st Iteration | 0.072000 | 0.135000 | 0.279000 | 0.315000 | 0.351000 |
| 4 | 2nd Iteration | 0.053453 | 0.175163 | 0.623593 | 0.755213 | 0.888416 |
| 58 | 56th Iteration | 0.000000 | 0.333333 | 0.558014 | 0.826941 | 0.137224 |
| 59 | 57th Iteration | 0.000000 | 0.333333 | 0.764566 | 0.500884 | 0.461735 |
| 60 | 58th Iteration | 0.000000 | 0.333333 | 0.558014 | 0.874997 | 0.969290 |
| 61 | 59th Iteration | 0.000000 | 0.333333 | 0.764566 | 0.382820 | 0.116092 |
| 62 | 60th Iteration | 0.000000 | 0.333333 | 0.558014 | 0.826941 | 0.400198 |
| 63 | 61st Iteration | 0.000000 | 0.333333 | 0.764566 | 0.500884 | 0.936154 |
| 64 | 62nd Iteration | 0.000000 | 0.333333 | 0.558014 | 0.874997 | 0.233100 |
| 65 | 63rd Iteration | 0.000000 | 0.333333 | 0.764566 | 0.382820 | 0.697182 |

Figure 1.03. **Spreadsheet for the function $cx(1\text{-}x)$. The result of one calculation is used as the value of $x$ in the next calculation. The value of the constant $c$ is found in Row 1. Columns B through F are for values of $c$ = 0.8, 1.5, 3.1, 3.5, and 3.9, respectively. The initial value of $x$ is set to 0.1000 (Row 2). Note that the outcomes vary, with stable results for B and C, a bistable result for D, a tetrastable result for E, and a chaotic result for F. The 63 iterations of each formula are performed almost instantaneously using a spreadsheet (Microsoft *Excel*). Changes in the values of $x$ and $c$ can be made very quickly.**

Graphing calculators can include what amount to small spreadsheets. Chemists often use spreadsheets to calculate titration curves, and compare the calculated curves with experimental results. Graphing calculators, together with calculator-based laboratories (CBLs), can display experimental data together with calculated curves. Figure 1.04 shows a calculated titration curve obtained with a TI-83 graphing calculator. Remarkable advances like this have become commonplace over the last 30 years. This sort of technology is leading to strong

collaborations between science and mathematics teachers at the secondary level, something rare just a few years ago.

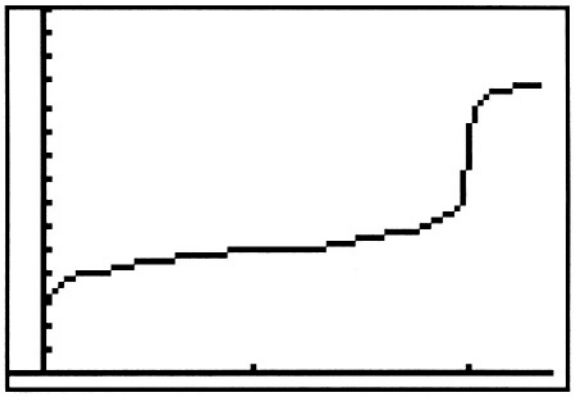

**Figure 1.04. Theoretical curve for "titration" of weak acid using a strong base; graphed using a TI-83 calculator. Graphing calculators are becoming commonplace in classrooms.**

## CURRICULA

Curriculum reform should attend to the impact of a seemingly endless stream of cognitive artifacts. Polarizing terms such as good/bad or fundamental/applied often cloud curriculum development issues. For task after task in this era, the carbon cognition of the human brain is being supplanted by the silicon cognition of a desktop computer. Curriculum development is an immense struggle during times of rapid change.

As tools emerge, and tasks change, curriculum reform follows. For example, there has been substantial discussion of the "role of technology" in algebra teaching [Waits & Demana, 1992; Dugdale et al., 1995]. Evidence about tool use has emerged in the teaching of mathematics. Graphing calculators and symbolic algebra programs have come to be studied first. Both of these exemplify the kinds of digital tools scientists have available today. While fears about the loss of core skills linger, objective studies support the notion that, when students use these tools extensively and nearly exclusively (as opposed to mixed calculator and conventional pencil and paper, for example), there are substantial learning gains [Pressley & McCormick, 1995, p. 434]. Students using graphing calculators have deeper and more extensive understandings of the concept of a function than those using pencil and paper. Other studies support the same kinds of gains for symbolic mathematics programs [Cooley, 1995; Park, 1993; Porzio, 1994].

## THE MEDIUM IS THE MESSAGE

The research results on graphing calculators and symbolic mathematics programs are not surprising. To use the new tools successfully one must understand the concepts in a deep way. You can't just bluff your way through or get by as the result of demonstrating simple calculating skills. Earlier generations were asked to perform on examinations involving demonstrations of skills such as differentiating a function or solving a differential equation. Most of the skill aspect of those tasks has been subsumed by computers or calculators. Planning solutions to problems is most of what remains for the professional who uses these new tools. For both the professional and the student, more and more challenging problems can be worked in the same time. As a result, the kinds of experiences a student can have today are much broader than was possible in any previous generation. The learning loads are meaningfully increased, too [Runge et al., 1999]. Thirty years ago, asking students to solve many deep and complex problems at the levels typically expected in current courses would have constituted cruel and unusual punishment; the amount of attendant busywork was massive.

When **multimedia** technologies become the means of instruction, substantial learning gains may result! These gains are, however, by no means automatic. Lecturers using multimedia tools may feel much better about their classes, and their students may rate those classes more highly than conventional classes, but large learning gains are not inevitable [Cassanova, 1996]. Gains seem to appear mostly when the students themselves use the tools actively and extensively [Cooley, 1995; Park, 1993; Porzio, 1994].

While the attention of teachers certainly has focused on these issues – comparing current and previous learning outcomes in the context of previous learning goals and objectives, this really is not the principal issue. Computer tools, which Norman would describe as cognitive artifacts, have supplanted their predecessors. This no longer is debatable; it is an everyday reality. Because students must develop serious expertise as computer users in order to participate effectively and functionally in their personal and professional worlds, schools at all levels need to be teaching expert use of those devices. It is not really a matter of teacher choice; it is a matter of ethical responsibility.

## WHY TEACHERS USE THE WEB

The Web components in your teaching help to prepare your students for their world of work. The Internet, especially as used in the context known as the Web, has begun a remarkable communications revolution. Your students are almost certain to use the Web.

In addition, the Web affords you with three very important instructional opportunities:

- anytime, anywhere medium (like the modern telephone)
- nearly generic multimedia delivery system
- capability for supporting **active learning** systems

Early results suggest that the Web supports student conversations and exchanges at least as well as does the traditional small-group classroom. Very surprisingly, rather than engendering a feeling of disenfranchisement by the circumstances of distance, most effective Web-based learning situations seem to lead to increased senses of camaraderie and inter-student support.

## GOALS OF THIS BOOK

This book is for those who teach. *Web-Teaching* is the first book to consult when you are thinking about redesigning your instruction for computer delivery. *Web-Teaching* has two principal goals:

- to describe what is possible on the Web, and
- to identify instructional strategies that are likely to be effective.

The first goal is quite concrete. For example, modest use of the Web will permit you to "can" your lectures for delivery during a modified classroom session, and to provide readily student support materials that once were difficult to deliver. It is important for you to have some idea of what is possible. This is a dynamic target; it is unlikely that the technology available at the moment this book goes to press will be the same as that available when it sells in printed form just weeks later. The half-life of the information provided for much of the book's contents is better measured in months than years. Most of the chemistry content in a 1958 college general chemistry book still remains correct and up-to-date. Essentially none of the computer-related material presented in this book existed in 1958. In fact, much of it is less than 2 years old!

Our second goal is to make recommendations for instructional strategies based upon research. Research in education always seems shakier than research in fields like chemistry or biology. Education is a field notorious for seemingly whimsical innovation, usually not sustained very long [Ellis & Fouts, 1993]. The notion of having students actively engaged while learning (as opposed to passively listening or reading) is emerging with substantial research support [Ellis & Fouts, 1993].

Some approaches to teaching, student learning, and instructional design make a great deal more sense than others. This is a book written by teachers for teachers. We hope our readers will come to favor some instructional strategies over others.

*Web-Teaching* is not a book for techies. This book will not provide you with all of the technical tools needed to create instructional materials. Many other books deal with the specifics of harnessing appropriate technologies. This is the teacher's first book – the one to read and reread as you plan Web-based instruction.

## THE MEDIUM FOR THE MESSAGE

If you are asking yourself, "Why write a book instead of using the Web?" then you are an excellent candidate for *Web-Teaching*. The first edition was written using a word processor. This second edition was written first as a Web product, and then converted to paper. Books are not likely to disappear anytime soon, however. Book production and sales were much higher after the introduction of television than before. Paper use increased after the development of computers. Portions of this book are available online at

http://dwb.unl.edu/Book/Contents.html.

One of the early discoveries about the Web is that students tend to print material for later reading – and they lose access to much information as a result.

## THE BOOK'S CONTENT

Each chapter in this book has specific purposes. Some chapters might be easily predicted, others not. For example, as **Web-teaching** spreads, the success of the experience for various audiences will be discovered. So far, it seems that learners who are good **self-regulators** fare better with Web instruction than do those who are not good self-regulators. For this reason, we devote Chapter 9 to self-regulation, and we try to emphasize the teaching of self-regulatory skills.

Many traditional courses involve the discussion and exchange of ideas between students. As a teacher contemplates switching from **synchronous** instruction (sit them all down in front of you at the same time, and get them talking to one another by any of dozens of strategies) to **asynchronous** instruction (at different sites and different times), then the mechanics and strategies for initiating conversations change. In Chapter 5, we point readers toward a variety of Web-based discussion strategies. Some of the chapters are very brief. The Web supports active learning strategies, and we discuss several. In *Web-Teaching* we argue in support of active learning. Finally, we've made a fairly big deal in this chapter about computers, their impact, and the overarching reason that all teachers should use computers as they teach. As we note in Chapter 4, there is a metacognition of computer use. We have offered numerous suggestions as to how teachers might incorporate teaching about this area within the context of their various disciplines.

### Too Soon To Tell

How effective is Web-teaching? Well, a lot depends on what you mean by teaching, and what you mean by effective. Doomsayers seem to have been incorrect. At the same time, no courses or systems have yet emerged that would support wholesale migration from traditional teaching to Web-teaching. Early returns offer unambiguous support that Web-teaching serves some populations very well. There are only a few solid studies related to Web-based learning outcomes.

## THE TEACHER/STUDENT, SERVER/CLIENT METAPHOR

This rather remarkable, dynamic system we call the Web often is spoken of in terms of two functions, **clients** and servers. Clients are the end users, the ones that make use of browser software. Servers are the sources of information, the repositories. Server software is what makes it possible for an Internet node to send files to clients. In principal, any node or "end" of the Internet can, at one and the same time, be both a client and a server.

In *Web-Teaching,* we think of teachers as controlling the servers. The teachers decide what will be made available to serve, and which returned information will be recorded, if any. In Web-teaching, the students run the browser software and sit at the "served" computers, the so-called client terminals.

This is not meant to be taken that we adhere to the "sage on the stage" instructional model rather than that of the "guide at the side." When push comes to shove, however, the teachers decide who will earn the credit – and the client/server model best describes the respective roles.

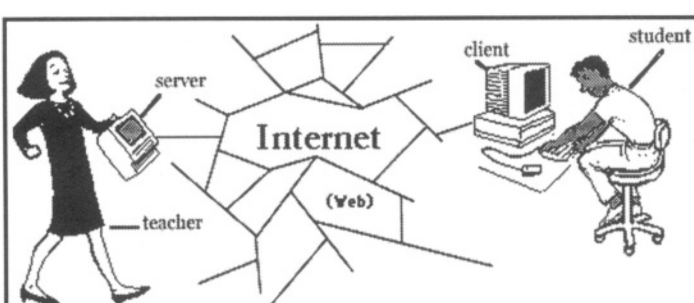


Figure 1.05. The Teacher/Student Server/Client Metaphor of *Web-Teaching*.

## GLOSSARY

active learning: learner speaks, writes, performs experiments, plans, etc., as opposed to reads, listens to lecture, etc.

asynchronous: used as an adjective in Web-teaching jargon to describe situations where learners and teachers are separated in time and usually in space.

browser: software that makes use of URLs and the Internet to obtain information (files) from a server. Most have graphical user **interfaces** (GUI). Examples are *Netscape Communicator* and *Internet Explorer.*

bulletin board: a scheme for accessing posted messages. One computer would be designated as a host. Access was by telephone through modems.

clicking, click: to depress a mouse button; depression of button on a mouse.

client: in Web jargon, this is a receiver of information, a connection to the Web where browser software is used to view materials served from somewhere else on the Web. The "opposite" term is server.

cognitive artifact: according to Donald Norman, a device created to assist with a task that changes in a fundamental way the skills needed to succeed with the task.

e-mail: electronic mail delivered and received over a digital network such as the Internet. Software creates, transmits, and interprets the data streams.

ftp (file transfer protocol): a procedure for transferring files from one computer to another.

hyperlinks: attributed to Ted Nelson {U01.03}, hyperlinks allow one to access documents in parallel, to jump from one to another on the basis of both content and relatedness. For example, if the name Ted Nelson in this description were hyperlinked, placing the cursor on the name and "clicking" would bring up information somehow related to Ted Nelson.

hypertext: text linked so that the user can jump from one idea to another, usually by clicking on text.

HTML (Hypertext Markup Language) HTML tag: The Web involves sending files around the network in extremely simple formats so as to make them machine and platform independent. Inside these text files are "tags" read as

text but demarked in such a way as to provide information to the software (browser) about how to display the text. This is not an exact method; the files may appear rather differently on different browsers.

interface: as used here, name given to the computer screen or screens that enable a user to interact with a computer program.

Internet: a dynamic electronic network that permits computers connected anywhere on that network to exchange information. The Internet is essentially a worldwide network.

IP address: computers on the Internet are identified by a unique number called an IP address. These consist of four numbers between 0 and 255 separated by three periods (dots). IP addresses are provided Internet Service Providers (Chapter 4).

multimedia: forms of media, such as video, audio, text, and images.

news groups: originally, a bulletin board organized by topic. News groups have evolved to offer systematic access through e-mail or Internet.

node: a computer which serves as a point of exchange in a an inter linked group of computers, receiving, routing, and retransmitting information. Node is also used to indicate any computer on the Internet.

self-regulator (self-regulation): a learner who actively controls his or her learning by use of good strategies for cognition and motivation.

server: computer connected to the Web that transmits files. Most computers can be made into servers given suitable software. *WebSTAR* can make nearly any Macintosh into a server. The “opposite” term is client.

spreadsheet: software to handle systematic arithmetic and logic operations. Originally created to help with bookkeeping operations. (Spreadsheets vaulted personal computers to the desktops of everyday business managers.)

Sputnik: a space satellite launched by the Soviet Union. The Soviet Union was a political entity that included Russia. After World War II, the United States and the Soviet Union engaged in a world wide political activity known as the “Cold War.”

synchronous: used as an adjective in Web-teaching jargon to describe situations where learners and teachers work at one common time and usually in one commonplace.

telnet: a remote terminal connection service that allows a user at one terminal to interact with systems at other sites as if the user's terminal were directly connected to the other sites.

URL (Uniform Resource Locator): a five-part information string that conveys a type of operation (e.g., http, ftp, mailto), the **IP address** of a machine (or its alias) where the desired file is located, the path on that machine to the file, the name of the file, and, through 2 to 4 letters appended to the file name in what is called an extension, information about the nature of the data in the file.

Web-teaching: instruction or training conducted using the Web.

Web, World Wide Web WWW: a scheme for using the Internet to exchange information in hypermedia formats.

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# CHAPTER 2

# Research on Teaching; Web Issues

## THE BIG PICTURE: LEARNING AND NEURONS

Modern brain research verifies that learning involves modifying neurons. In particular, neurons are interconnected by biological entities called synapses. Stimuli (perceptions) create electrical signals that move through neural tissue such as brain tissue by bringing about temporal changes in synapses. If, during some rather brief interval, many synapses that touch a neuron fire and release neurotransmitters, the cumulative effect is to cause a drastic change in the affected neuron. It fires. The result is that synapses emanating from the recently fired neuron pour chemical neurotransmitters into their synaptic clefts and, should sufficient numbers behave similarly and more-or-less synchronously, the neuron upon which they impinge will fire.

The massive biological circuitry involves many complex and often poorly understood features. In the end, however, neurons connected to muscles fire causing muscles to move in some fashion. This may create an observable effect which, when evaluated in the context of many muscles moving over a brief span of time, is called a behavior. Learning involves neuron modification. It involves changing the strengths of the synaptic connections between neurons. Over time, as the result of learning, different muscles react to neural inputs, and we say that different behaviors have resulted – that behavior has changed.

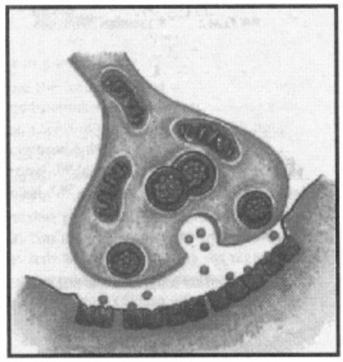

**Figure 2.01. Synaptic connections between nerve cells. Neurotransmitter molecules (small circles) are produced in the top nerve and encapsulated within vesicles (top, large circles). The vesicles migrate to the synapses such as the one illustrated here. An electrical impulse causes the vesicle to merge with the cell wall and disperse its contents into the space between cells (the synaptic cleft). The neurotransmitter molecules diffuse across the cleft, and bind to sites on the opposite side (lower side in Figure 2.01). Once sufficient synapses have fired, the lower cell generates an electrical impulse causing its synapses to send its neurotransmitters into still other synapses. In the connectionist model, changes in synapses ultimately account for learning.**

Books concerning cognitive psychology nearly always have at least one chapter devoted to neurons [for example, see Pressley and McCormick, 1995]. Pacesetters even have dared to suggest biological bases for how humans think [Crick, 1994]. The links between this theoretical base and classroom practice are very weak, however. Much current learning is described using a jargon developed under the name, constructivism. A key notion of constructivism is that learners construct their own knowledge. We interpret this to mean that the process of neuron modification is such that a teacher cannot transfer, whole and intact, either copies of his/her neural connections or some other idealized set of such connections to learners. Indeed, neither near copies nor even reasonable facsimiles appear in learners.

Understanding neural models for learning is a complex business. It is far beyond the purpose of this book. It is a far too common practice in studying learning to reduce complex systems and situations to simple cases described by trivial metaphors. At the risk of being guilty of such poor practice ourselves, we call your attention to some experiments conducted about learning in environments pervaded by controlled odors [Schab, 1990]. In one study, a large student group was divided. One half of the group received instruction in the presence of the odor of chocolate, and the other half with the odor of mothballs. For testing of material learned, each group was further halved. Half of the chocolate treatment group was tested in the presence of chocolate odor, and the other half in the presence of mothball odor. The mothball group was treated in a

parallel fashion. The result? Those taught in the presence of chocolate odor tested better in chocolate; those taught in the presence of mothball odor tested better in mothball odor. If you are a person that believes learning is disembedded from its contexts, this experiment will give you nightmares. If you believe that contexts affect learning, then these results will validate your beliefs.

Although most learning theories fail to explain this outcome, the neurological model has little difficulty with it. The odors are perceptually detected, integrated into a holistic neurological mass of information, and increase the perceptual similarities in the presence of stimuli (test questions) so as to enhance performance. Whether pleasant (chocolate) or unpleasant (mothballs), the presence of the same odor during testing stimulates the same neural paths present during learning and thereby enhances the likelihood of a correct response.

There is a great deal of evidence supporting a neurological basis for learning. Near weekly revelations appear regarding details of neural mechanisms. However, these are of little use to the teacher. Successful teaching still relies upon information far removed from the neurological phenomena underpinning learning at molecular and cellular levels. *Rethinking Innateness* [Elman et al., 1996] gives an extremely powerful account of the neurological basis for learning.

## TEACHERS AND FACE VALIDITY

A proposition has **face validity** when it seems reasonable, rational, and appropriate without any need for further justification or research.

> Face validity is concerned with the degree to which a test appears to measure what it purports to measure, whereas the other forms of test validity ... provide evidence that the test measures what it purports to measure.... Persons tested with such measures [ones without face validity] often reject the results or refuse to cooperate because they cannot perceive any relationship between the test and the maladjustment. Thus, face validity can be an important consideration in selecting tests for use in situations where subject acceptance is essential. However, a test can appear to be valid when evidence for the other kinds of test validity indicates it is not. Therefore, let us emphasize again that face validity can only supplement information about predictive, concurrent, construct, or content validity of a test and can never take the place of such information.
>
> Borg & Gall, 1989, pp. 256-257

In educational research, numerous situations arise where face validity is all that supports the choice of a strategy or methodology.

### A Few Successful Teaching Strategies

Educators often search for the holy grail of teaching, a goal well summarized in a paper by Bloom [1984]. Numerous research studies suggest that some teaching strategies lead to substantially more positive learning outcomes than others.

Demanding that students learn material to a minimum standard – often called mastery learning – is extremely effective. Mastery strategies, discussed further in Chapter 15, involve frequent testing, with content re-tested until standards are met.

Cooperative learning, where learning tasks are subdivided within a small group of learners responsible for teaching one another different aspects of a learning problem, is moderately effective. Strategies for supporting cooperative learning are discussed further in Chapter 5.

The most effective Web-teaching materials require active learning. Teachers who demand active learning are likely to bring about substantially greater learning success than those who do not. Our advice is to keep the learners' brains running in high gear whenever possible; make learners work; keep learners active. Active learning is a component within mastery learning; students spend much time actively engaged in testing and feedback. Active learning is a component within cooperative learning; students are actively engaged in teaching part of the target content to other students.

***The Web supports active learning, mastery learning, and cooperative learning.***

### Active Learning; Interactive Teaching

The Web is a place where one can read and read, and then read some more – without being forced to respond in ways that demonstrate learning. Much of what is on the Web is ideal for learners who are successful as passive learners. A highly motivated learner may thrive on vast amounts of Web information.

Few students have deep motivation. Curriculum materials that force students to respond, to make choices, to perform, to organize, and to think deeply about the material have better outcomes, generally, than ones in which they just read or listen. The former behaviors often are labeled under the heading of active learning, and much research indicates that active learning is more effective than passive learning. With curriculum materials that encourage active learning, the teacher is mainly a silent facilitator.

> Typically, active learning is defined in contrast to the worst of traditional teaching in which teachers actively present information and students passively receive it. This definition says more about what active

> learning is not than about what it is. And since we know of no generally agreed upon definition of active learning ...
>
> Meyers & Jones, 1993, p. 19 (*Promoting Active Learning*)

Research usually does not support the teacher-centered model as a preferred model, especially when pitted against active learning models. As a psychometric construct, however, active learning leaves much to be desired. The term active learning echoes in the halls of curriculum and instruction departments, but usually remains absent from works on teaching written by members of educational psychology departments. If one looks at materials written by learning experts, active learning usually does not seem to appear in either the tables of contents or the indexes.

We advocate active learning strategies because, when well developed, their effects can be substantial. Several chapters of *Web-Teaching* have been devoted to active learning strategies. Just clicking around the Web (surfing) is not an especially effective learning strategy. Purposeless surfing of the Web is not likely to bring about learning gains. Indeed, purposeful surfing may be very limited in its impact.

## TECHNOLOGY AND TEACHING

Significant confusion arises when teachers use the word technology in the context of teaching. In today's world, technology generally is interpreted to mean computers when applied to teaching. Technology may be broken down into two areas: the professional tools which incorporate small (or not so small) computers, and the communication systems that make use of computers.

### Professional Tools

Several studies have been reported in which graphing calculators (small computers) or powerful software *(Mathematica, Maple,* molecular structure software) were incorporated into teaching. College-level students using graphing calculators came to understand the concept of function substantially better than did students in traditionally taught control classes [Pressley & McCormick, 1995, p. 434]. When the software is merely demonstrated in lecture classes, learning gains are small or nonexistent [Klein, 1993]. In chemistry, students sometimes lost ground in classes with technology-based software presentations but little or no learner practice or feedback [Cassanova & Cassanova, 1991; Cassanova, 1996]. When the technology tools are put in the students' hands, and the instruction modified to include activities that illustrate the power of the software, learning gains are often substantial [Hembree & Dessart, 1986; Cooley, 1995; Park, 1993; Porzio, 1994]. Again, when teaching newer

technology tools (calculators, software), strategies for active learning consistently seem to give better results.

Teaching with technology tools requires some accommodations, however, and faculty still struggle to achieve a balance between the demands of the disciplines and the details of the technology interfaces (Runge et al., 1999).

### Communications Tools

The Web is a communications tool that all professionals use in similar ways. The most powerful learning experiences are those that engage students deeply in meaningful ways. They force active learning, and they provide realistic environments that have a way of nurturing motivation. Real-world activities are limited and still relatively unusual as far as being included within routine school-based instruction. Teachers struggle to create effective active learning environments in classrooms and laboratories. The challenge is to incorporate the principles of active learning into Web-based learning. Because the instructional delivery system is at the same time the worldwide scientific communication system, exciting new opportunities for involving students are emerging. A consortium of physical chemistry teachers reports good results with a small number of very challenging activities taught using the Web (Sauder et al., 2000). Poë describes the use of problem based learning in large lecture classes (see Chapter 5).

Clever teachers have found ways to engage students. Some projects, like the Monarch Watch {U02.01} and Journey North {U02.02}, recruit students as reporters to track migratory patterns (Figure 2.02).

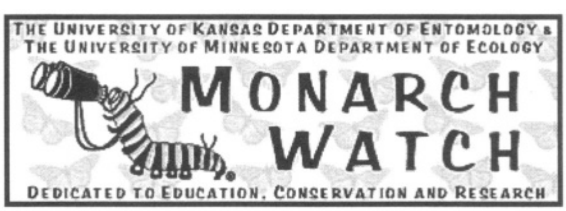


**Figure 2.02. Screen capture from the home page of the Monarch Watch {U02.01}, a national Web-connected project focusing on the Monarch butterfly and its spectacular fall migration. With permission of the Monarch Watch Project.**

## MULTIMEDIA: DEVELOPING A PERSPECTIVE

Multimedia is a term whose implications have evolved. Thirty years ago in teaching, it implied using a combination of slides, super-8 movies, or TV. Today it implies using computers. Computers deliver text, pictures, **movies**,

**animations**, molecular structures, sounds, or music, and can interact with virtually every sense except taste and smell. The Web is a communications system far broader than an electronic text with color pictures. Rather, it is a **comprehensive multimedia delivery system.**

Multimedia instruction passes the most important test that instructional materials must pass before they are used in classrooms, namely, face validity in the eyes of the teacher. When committed teachers see an excellent multimedia piece developed to teach some aspect of their discipline, usually their eyes widen, and broad smiles spread across their faces. They are impressed. The potential for creating media to portray phenomena visually and aurally is very great. We are no longer constrained by our students' ability to conjure up images in their minds to fit our verbal descriptions. Indeed, we may even introduce biases far and wide about the nature of phenomena through the teaching images we can create today.

There is every reason to believe, however, that multimedia materials in and of themselves do not lead to enhanced learning. Indeed, they often lead to slightly lowered learning when compared with comparable text materials. When adjusted to account for differences in active learning components, research studies aimed at studying media often show no significant learning differences [Clark, 1983; Clark & Salomon, 1986; Heinich et al., 1996]. The active learning is the key, not the multimedia.

While transforming content to a multimedia format may be a "cool" and popular thing to do, it by no means ensures learning gains. Salomon (1986) reported that perceptions of the difficulty of the medium lead to differences in mental effort by students. As a result of the greatly increased power of computers and lowered costs for creating and delivering multimedia, there is an emerging feeling that teaching can be improved by extensive use of multimedia in large lecture courses. Students favor multimediated instruction over conventional "chalk and talk" instruction [Ansorge & Wilhite, 1994; Pence, 1993]. They rate mediated courses more highly, and the instructors therein more highly than they do traditional courses. The results of Salomon appear to be quite replicable when the media are traditional chalk talk versus highly mediated lecture. Thus far, however, demonstrated learning gains from multimedia instruction have been particularly disappointing.

> Last year, I moved my general chemistry lecture from overheads to computer-based. It was a lot of work ... Has it improved my teaching? Yes,... it's forced me to be more organized. Has it improved student satisfaction? Absolutely, much more than one would expect.… Has it improved student learning? Um, well, there's the rub. I can't think of a good way to assess this. ACS exam scores haven't really improved. What's more, it seems to be an additional benefit for the motivated students (who download the notes before class and then follow along), but the poorer students just review it and then think they've studied.
>
> Kahlow, 1998

We do not challenge the notion that attitude is important, but rather assert that learning is not related in simple ways to attitude. In research about learning from multiple forms of media, Clark concluded that students often prefer the medium from which they learn the least [Clark, 1982].

Some teachers may take this to mean that, if we make students a bit less happy, they may do better. That's not what this means at all! Quite the opposite is true. Let's say you have a course where the content is well defined by a book and some other media materials. You can present the material, or you can engage in activities to motivate the students to work with the material, especially with mastery learning as a goal. Our experience suggests that you'll get better results if you motivate first, and then cover the material. If you already have strongly motivated students who are good self-regulators, just cover the material.

### Learning From Multimedia Instruction

Meta-analysis is often used in education. In this research technique, quantitative criteria for research are set forth. The literature is then searched for studies meeting these criteria, and the results of all such studies are considered together. Fletcher-Flinn & Gravatt [1995] reported a mean effect size of 0.24 from a meta-analysis that included 120 studies on the efficacy of computer assisted instruction. Liao [1998] reports a grand mean effect size of 0.48 from a meta-analysis of 35 studies involving hypermedia instruction. However, most of the individual studies that were used to generate these meta-analyses used no control for active learning components. Very often, the multimedia materials included interactivity that is not possible with print materials. Early research results do not support the notion that special gains are attributable to hypermedia [Dillon & Gabbard, 1998].

It is certain that the careful design of instruction is of primary importance. Some media enable certain types of instruction. Issues two and three of the 1995 Educational Technology Research and Development contain several excellent articles on media and instructional design [Clark, 1995 a, b; Jonassen et al., 1995; Kozma, 1995 a, b; Morrison, 1995; Reiser, 1995; Ross, 1995 a, b; Shrock, 1995; Tennyson, 1995].

We advocate the use of multimedia, especially when it can capture phenomena and portray them in ways heretofore impossible. But remember to incorporate active learning strategies.

***When designing instruction, your time will be best spent developing and implementing active learning strategies.***

## MULTIMEDIA IN ACTIVE LEARNING SYSTEMS

Multimedia often is embedded among numerous changes that include significantly increased expectations for active learning. There have been many reports by Stanley Smith and his collaborators, especially Loretta Jones, in which chemistry learning systems have been developed that make extensive use of multimedia [Smith & Jones, 1989]. Smith's work in this area began during the 1960s, and is especially noteworthy. Smith's interactive programs were developed for Apple II hardware; they evolved through development of videodiscs, and have emerged with interactive **CD-ROM-**based materials.

Smith describes learning systems, ones that demand active participation on the part of the learner. To judge the importance of multimedia to his results, multimedia issues need to be separated from active learning issues. However, this separation is difficult since there would be no realistic way to try to create a learning system like Smith's without using multimedia. What would be the outcome if the systems Smith describes were used as a lecturer's tool in slick multimedia classes during which the lecturer made the choices and spoke aloud while the students listened? We suspect that the students' evaluations would be good, but that few learning gains would be demonstrated.

Pence reports very favorable student responses to multimedia, and implies that learning improvements are likely [Pence, 1993]. His use of multimedia, however, involves brief presentations followed by cooperative learning activities between pairs of students in the class. Any significant learning gains in this environment may be more related to the active learning strategy carefully integrated with the multimedia rather than just the multimedia alone.

Designing learning research is not an easy matter. Even in the best of circumstances, the instructional multimedia are embedded within an instructional delivery setting, and it is difficult to simply replace one medium with another. Often a system that works extremely well in one setting proves not to "have legs." The **audiotutorial system** for teaching introductory botany created by S. N. Posthlewaite was remarkably effective at Purdue. Others who adopted this approach to teaching could not always make it work to the same degree. One of the authors of this text attended sessions of that system during a visit to Purdue; Posthlewaite's was a wonderful course, a model of active learning!

Along similar lines, **Keller Plan** courses flourished during the late 1960s and early 1970s [Keller & Sherman, 1974]. In spite of their success, few of these courses are taught today. It took more effort to run Keller courses than either teachers or students were willing to expend for the increased learning. Today, that's changed. After a substantial initial effort, the teacher can use network- or Web-delivered materials to sustain powerful Keller Plan courses.

## Multimedia Superiority Is Rarely Demonstrated

> Learning is more correctly attributable to well orchestrated design strategies than to the inherent superiority of various media.
>
> Hannafin & Hooper, 1993, p. 192

There are times when intuition leads a teacher to suspect strongly that a multimedia approach will be superior. This again is a face validity matter.

With the advent of powerful computer animation tools, trying to get students to be able to think of chemical phenomena in atomic and molecular terms seems ideally suited for extensive use of multimedia. In a specific test of one aspect of multimedia learning, Williamson & Abraham [1995] report substantial learning gains when animations and visualizations (created by Gelder [1994]) were used to exemplify phenomena at the molecular level. The durations of the animations were brief, as was the number of exposures to them. Using an instrument designed specifically to assess learning in this concept realm, Williamson & Abraham found significant effect size of the positive impact of using the multimedia. Just seeing the animations in lecture led to large gains in scores on the measuring instrument; no additional benefit accrued from additional access during computer lab time. However, gains did not show up on overall course exam scores, individual items, or attitude assessments. Despite the lack of improvement of overall scores, this work is cited informally by chemistry educators as support for the multimedia effort. If a dozen studies like this showed similar results, perhaps the enthusiasm of this support would be justifiable. Abraham is surprised by the large size of the effect on the measuring scale used given the brief duration of the intervention. To one who holds views that learning is neurologically based, the outcome implies either that the learning is trivial (in conflict with our personal senses of face validity on this issue), or that the assessment is somehow trivial and is missing the mark. Abraham points to similarly vexing gains in the area of creativity subsequent to brief interventions [Abraham, 1996].

The materials tested by Williamson & Abraham were developed for an AP Chemistry course taught via satellite. In spite of the quality of the materials and the demonstrable excellence of the teacher, student success rates as judged by AP scores were “average.” Although geared toward AP, many students chose not to take the AP test. When used throughout a well-designed and well-delivered course, evidence of special learning gains from use of the multimedia materials disappeared [Williamson & Abraham, 1995].

## The Virtues of Multimedia

You might think from the preceding work that we are media bashers. In fact, we’ve spent big chunks of our careers developing multimedia materials of

all sorts. Media let you present conceptual materials that are difficult, perhaps nearly impossible, to present with text alone.

For example, animations afford an excellent means for teachers to convey concepts. Increasingly available, packaged animations can provide a visually stimulating and enlightening view of confusing concepts. Without animations, a teacher can talk about these concepts at the podium, fumbling with chalk or overhead projector pens to try to explain complex ideas.

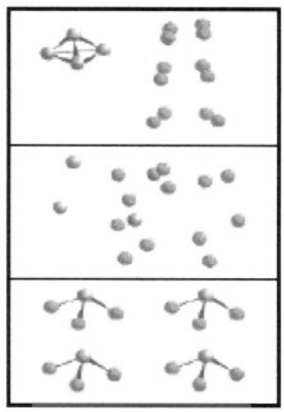

**Figure 2.03. Three frames adapted from the elegant animation by Kotz & Vining {U02.05} of the formation of phosphorus trichloride from phosphorus and chlorine.**

Gelder's animations convey to students the concepts of how one might view the atomic and molecular world. *ChemAnimations* [Gelder, 1994], and the *Saunders Interactive General Chemistry CD-ROM* developed by Kotz & Vining [1996, Figure 2.03] are examples of commercial materials that afford chemistry teachers the easiest way to present complex ideas with minimal teacher preparation or media materials.

*Geometer's Sketchpad* {U02.03} and *Cabri Geometry* {U02.04} provide similar assistance to the mathematics teacher, allowing teachers and students to create dynamic sketches of geometric concepts. Some of the mathematician's professional software applications have built-in tools that simplify greatly the production of demonstrations and experimentation by both students and teachers.

Animations also may serve the purpose of presenting data from an entirely different perspective. That is, the animation may not present information to answer traditional questions in a topic, but rather to generate new questions. Students may see patterns in the data as represented by the animation, causing them to reanalyze the data along new conceptual lines.

> Computer-assisted geographic visualization is fundamentally different [from earlier formats]. The computer facilitates direct depiction of movement and change, multiple views of the same data, user interaction with maps, realism (through three-dimensional stereo views and other techniques), false realism (through fractal generation of landscapes), and the mixing of maps with other graphics, text, and sound.
>
> MacEachren & Monmonier, 1992, p. 197

## ARE ELECTRONIC CONVERSATIONS EFFECTIVE?

Face validity supports still another notion, namely, that certain kinds of teaching and interaction require face-to-face meetings and cannot be conducted electronically. Evidence in support of this notion is intuitive rather than based on the literature. *Learning Networks* provides some (understandably biased) commentary.

> The traditional face-to-face classroom learning situation is generally assumed to be the best to support learning, with other learning modes perhaps perceived as less effective. There is no evidence to support this assumption. In fact, quite the opposite is true: Online environments facilitate learning outcomes that are equal or superior to those generated in the face-to-face situation [Hiltz 1988, 1994; Wells 1990].
>
> Harasim et al., 1995, p 27

The three references cited in the above article included two by one of *Learning Networks* authors. Early experience with Internet-based learning activities supported essentially every conclusion drawn in *Learning Networks* [Liu, 1996 {U02.07}]. There is evidence, at least with graduate courses and adult learners, that electronic conversations are every bit as effective as in-classroom discussions, and often much more so. At the University of Nebraska, hundreds of sections of adult learners have been involved in asynchronous discussions, and most instructors report that extremely effective, sustained discussions have taken place.

Instructors experienced in this technique spend considerable effort developing discussion questions. Views about when to join in the conversation remain under study. We revisit this issue in Chapter 5.

You and your students no longer need to be time bound. A student can log on at essentially any time of the day or night. The student need not be place bound; access can be from wherever there is Internet access.

Imagine yourself having an evening conversation in which you and a student are each chatting over a computer linkup. You are both in your respective homes. You see and hear one another. You share a **whiteboard** on which both of you can see changes made by the other. This rather personalized interaction, not particularly bound in time or place, is now possible and is becoming commonplace.

Questions about online discussions for undergraduates remain. There is one report suggesting that synchronous chat sessions may be especially attractive to female students [Kimbrough, 1999].

## THE BOTTOM LINE

Face validity might suggest that multimedia instruction will lead to superior learning, and that replacing face-to-face discussion with asynchronous discussion will lower the effectiveness of discussions. Consistent early data suggest quite the opposite in both cases.

Learning from multimediated instruction, all other things beings equal, is similar to or possibly a bit lower than from conventional instruction. Electronic discussions, on the other hand, hold up very well when compared to traditional, in-classroom discussions, and even may have some advantages.

## THE WEB AS A DELIVERY MEDIUM FOR INSTRUCTION

It is clear that the Web is a low-cost delivery system for multimedia! The Web can be nearly as passive as television in the early days of instructional TV. If one didn't have to click now and again, it would be every bit as passive. In some ways, "clicking" the remote on a cable TV may be more interactive; one decides after each click whether to stay on the current channel, or to click again.

Unlike traditional TV, however, the Web can be very interactive. The Web's greatest intrinsic power for teaching is that it encourages branched, nonlinear instruction. Not only can students jump around among the materials that you have created for them, they also can access materials created by others. Indeed, they can create useful materials!

Be warned, it is quite possible to access misinformation on the Web, even more easily than in your daily newspaper. Web-based misinformation is a problem. In McLuhan's sense of the term, everyone is a publisher [McLuhan, 1964]. McLuhan's reference was to photocopiers facilitating self-publication. It can be extended to the use of the Web, where personal Web pages almost have become a given. The Web is, in large part, a non-edited, non-juried publication medium. Web page writers have few, if any, restrictions on what they may publish. Where are the Web's editors? Who are the Web's editors?

In our first edition, we included the sentence: "We believe that some material requires face-to-face, press-of-the-flesh instruction." Frankly, we've been surprised at some apparent successes of Web instruction, especially in areas that we perceive to be value laden.

Opinions don't influence the mass (in grams) of a sodium atom, so this content can be handled at a distance. Technical content, and especially content

that is convergent (i.e., has a single answer), is readily taught on the Web. Without ever leaving his or her home, a teacher could handle 50 or 100 graduate students effectively in a course with technical content that now has just 10 or 20 enrolled students.

Both students and teachers seem to regard Web-teaching favorably in a very wide range of coursework. For example, reporting on outcomes for an undergraduate philosophy course, Hardcastle {U02.06} indicates that "students in [the] cyber version of Philosophy 1204 outperformed students in the traditional class on [a] majority of criteria that are of importance to philosophers, even though there was no difference in grades assigned." Wegner et al. [1999] {U02.07} report that Internet-based delivery of coursework "appears to have no negative effect on student achievement or on students' perception of their learning."

The Web (Internet or intranet) is going to be used for instruction regardless of what teachers think, feel, or do. It will be used even in the absence of demonstrable research support. As a communications system, especially relative to conventional teaching, it is less expensive. At the college level, many costs such as hardware, Internet linkup, cleaning, and air conditioning are transferred from the school to the student. Web-based instruction has happened, and it's growing.

### Teacher and Student; Server and Client

As the designer of Internet multimedia materials, there is a model that can serve you well. Think of the teacher as the server: what will the server do in response to a client (student) question or request? What should the student see (and hear)? What options should the student have? Should you empower them in a particular instance, or should you insist that they come to you for information and service? You need to decide where to put your programming efforts, if any, on the server side, or the client side.

A Web server is shown in Figure 2.04. Notice that the device is no different from other typical desktop computers. In fact, a server need not even have a dedicated monitor and keyboard!

Most of what users see on the Internet is client-side material. Branching from one page to another involves returning to the server. But many leaps are within pages. Most browsers support client-side **maps** that empower the user to make choices at the client side without returning to the server.

Interactive teaching requires that students create and transmit information, ask open-ended questions, and so forth. In the best of teaching situations, your learners will have browsers that use powerful tools you've created for them to accomplish these tasks.

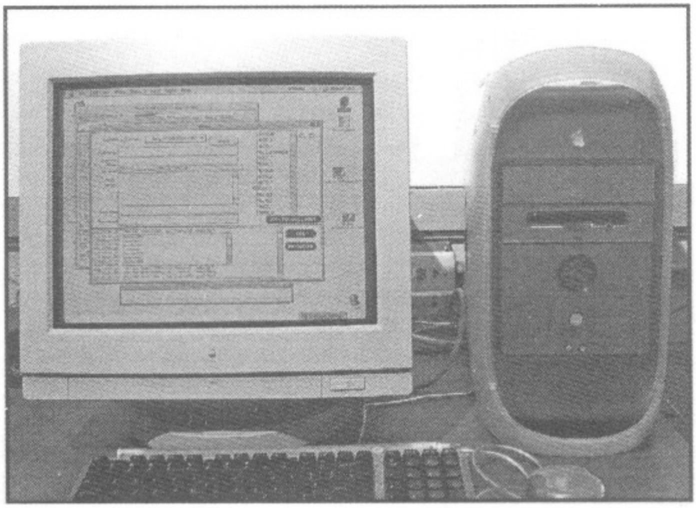

Figure 2.04. A server: a computer sitting on a desk, software, and a live connection to the Internet, make up the "window from the world" onto materials served by the authors.

## Branching versus the Voice of the Teacher

One feature of the Web is that, given free access, students can range far and wide. Judah Schwartz [1995] has discussed this issue. In conventional curricular materials, teachers had an excellent idea of where students had been, and what they knew - at least as far as a particular body of content is concerned.

If we don't know where they have been on the Web, how can the teacher have an idea about what the students know? Schwartz speaks of "the voice of the author," and suggests ways in which we might design software so as to provide very considerable freedom for readers (students) without giving them completely free range. Providing learners with choice is a tricky issue for teachers. Most learners, especially new learners, often become lost when provided with free choice. However, providing choice under controlled circumstances, or creating the illusion of choice, often has positive learning outcomes. The overall effects tend to be small, with results often reported as approaching significance. In a review of several quantitative hypermedia studies, Dillon & Gabbard [1998] suggest that the nonlinearity of hypermedia learning environments has negative learning outcomes for weak students. In our view, the generalizations suggested by Hannafin [1984] still provide reasonable advice with respect to learner control versus lesson control. Jacobson & Spiro [1995] make the observation that learning for conceptual transfer is better-served by hypertext instruction, while learning for memory is better-served by linear instruction.

### Hardware and Software; Platform Compatibility

A major advantage of the Internet is that teachers do not have to worry about software and hardware issues as much as in other situations. *Netscape Communicator* and *Internet Explorer* are powerful browser programs available for several platforms. There are dissemination issues, but cross-platform compatibility is reasonably easy over the Web.

If you want your students to download a spreadsheet file, or a formatted word processing file, you must decide what application/format to use. Teachers and students will be sending materials like wordprocessor files and spreadsheets back and forth. Forms, data, and reports must be transferable to and from the students. The net result is a need for platform independence. Since many software developers now write for cross-platform compatibility, a careful choice can often eliminate the need for picking a particular platform. Cross-platform compatibility is an important issue in Web-teaching. Thankfully, the Web browser and other software developers are aiming at its accomplishment.

### Replacing Teachers with Machines

Once you have your courses totally "**Webified**," will they still need you? Yes, for two reasons. Few humans are good enough at self-regulation that we can learn new, difficult areas outside of our expertise without some teacher. Also, as time goes on, learners will need to know more, not less. So, it seems inevitable that the number of students will grow significantly as the per capita demand for learning increases. If one really believes in lifelong learning, then an attendant implication is an increasing number of students – and teachers.

When one looks at distance settings for offering courses, early results suggest that the successful students are good self-regulators. Your authors find that, in our classes, many students are poor self-regulators. Many will flounder without us. Unstructured courses without fixed meetings times are anathema to poor self-regulators. These courses always seem to get the lowest time priority from the learner and, before long, the learning situation is hopeless.

## A PERSPECTIVE

Web-based instruction is coming whether we think it is a good idea or not. No vote will be taken. Many costs actually are lower. Except for cases such as the United States Medical Licensure Examination, there are few quality controls in education.

> Finally, we find it anomalous that no drugs, can be sold in the United States without first demonstrating, by experimental tests and clinical trials, their efficacy and safety, while publishers and schools can freely impose simplified readers and related schoolwork on children without having to produce experimental evidence of the efficacy or safety of their schoolbooks.
>
> Hayes et al., 1996, p. 506

With a few word changes, perhaps the same sentiment noted by Hayes et al. in reference to reading materials could be applied to Web-teaching. Times are certain to change. Imagine renting one electronic line to your house and using that for nearly all of your communication and video entertainment. That is one emerging change; costs are acceptable.

In the face of rising construction costs, legislators seem to be far less favorably disposed to build new schools than they were 30 years ago. But communications costs are decreasing. As a result, legislators seem anxious to incur the savings likely to be created as a result of using the Internet as an educational medium.

From our vantage point, Web-teaching is here to stay – at least for a while!

## GLOSSARY

animation: as used in *Web-Teaching,* a sequence of drawings or graphic images stitched together to form a movie.

audiotutorial system: structured learning system in which audiotapes provide the instructions. Many other media may be involved.

CD-ROM (Compact Disk Read-Only Memory): a storage medium, originally used mainly by developers to package their product. Now available for use by the consumer, both a write-once-and-keep-forever and a write/erase/rewrite form are available.

comprehensive multimedia delivery system: a delivery system capable of delivering nearly all media formats – text, sound, images, movies, etc.

face validity: a proposition has face validity when it seems reasonable, rational, and appropriate without any need for further justification or research. It describes a situation where an argument makes sense to the person hearing that argument to the degree that no further support is needs to affirm the validity of the argument.

Keller Plan: a self-paced, mastery teaching strategy. Information is broken into multiple sections or units, with tests for each unit. To proceed through the course, the student must achieve a mastery level of learning in each unit. Grades are based on how many units are completed.

map: a clickable image such that, if clicking occurs in a "hot spot," some action will be taken. On the Web, this usually means activating some hyperlink.

movie: in the context of this book, a computer file that may be played by a computer as if it were a motion picture.

Webify, webified: to make material ready for delivery over the Web.

whiteboard: shared screen in which two (or more) parties can discuss a document and independently mark the same document.

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# CHAPTER 3

# Software for Managing Web Courses

**Courseware** makes it easy to become a Web-based teacher. *After* an initial time investment, it probably pays back in teacher time.

Learning is a difficult business. Teachers bring about learning. If learning is difficult, who would be foolish enough to believe that teaching is simple? The Web is a communications tool. We've noted earlier that using this tool to communicate with your students is, in and of itself, important. As a teacher, you should model the best in techniques, including communication. Modeling may well be the most important thing that teachers do.

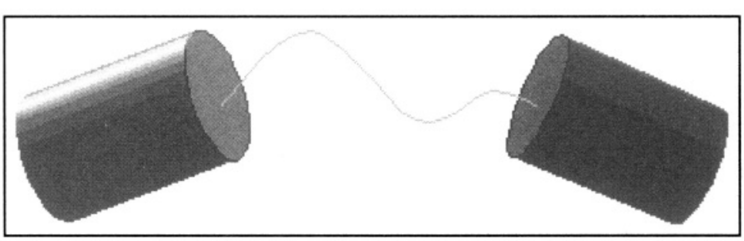


**Figure 3.01. Childhood communication system of two cans, connected with string through small holes in the bottoms, held in place with knots. When spoken into, the cans vibrate and the string transmits their vibrations.**

Early results suggest strongly and consistently that students in Web courses learn about the same amount as learners in conventional courses. Teachers have enormous opportunities to develop Web-based instruction. Many aspects of teaching change when using the Web, but learning outcomes need not be among these.

## COURSEWARE

A simple, effective path exists to develop a Web-teaching site for a course: use any one of several courseware packages. Courseware, or Web course management software {U03.01}, is designed to support the activities normally incorporated by a teacher in a course. Using courseware, many traditional teaching materials can be put on the Web – syllabi, schedule updates (e.g., how a snow emergency has changed the schedule), the "please see me if communications, etc. In the long run, computerizing these aspects will save you and your institution time. Ten years ago, it would have been essentially impossible to provide someone the opportunity to review every syllabus for every course in a school. Today, not only is this possible, but it is possible to compare similar courses at different schools around the world. There is evidence that students are checking Web pages before they enroll in courses [Chronicle, 1999]. According to a survey of 10,000 prospective college students [Seymour, 2000], **Web sites** are the third most important source of information behind campus visits and conversations with current students.

The development of courseware applications is emergent. The first edition of *Web-Teaching*, published in April, 1997, did not make much note of courseware packages. *Putting Your Course ONLINE,* a PBS-sponsored teleconference held in November, 1997, mentioned courseware. At the time of this writing (mid 2000), courseware development is a dynamic area. Numerous products are competing for space in this marketplace, and comparisons {U03.02} of the products are available. We can speak with some confidence about an emerging **feature set.** If you are not yet engaged in Web-teaching, you may be surprised by the features available for courseware.

A few courseware packages are easily managed from a teacher's desktop. More often than not, the software needs to be managed by someone with quite a bit of computer know-how, and the result is that these software functions tend to be centralized. Licenses for courseware packages can be costly. At the time of this writing, the University of Nebraska–Lincoln (UNL) campus supports about five different courseware programs. UNL faculty have developed an experience base that is shared widely on campus. Ours is not a one-size-fits-all campus. Many faculty have settled upon courseware named *CourseInfo* from Blackboard, Inc. {U03.03} Support for this software was assigned a full-time person, and involved about 3% of the credit hours offered at UNL after a single year. The

staff created a monthly “brown bag” discussion group, and information provided in this chapter owes much to the conversations held by that group.

**Free Course Web Site Service**

Blackboard.com provides a free service where instructors can create their own course site with their own learning materials and students. Provide a password to your students, or leave the course open to anyone for enrollment. With thousands of courses powered by Blackboard’s easy-to-use software, Blackboard.com is one of the world’s largest sites on the Web for online courses {U03.04}.

**The Feature Set of Traditional Courses**

Like software, courses have feature sets. The feature set of most college courses begins with a syllabus. In a well-worn course, the syllabus may not change much from previous offerings of the course. The syllabus may include a detailed, date-specific calendar including assignments, due dates, and exam schedules. It also may include submission guidelines for work required, and forms of assessment and feedback.

The feature set also includes types of lessons and materials. Lectures, discussions, videotopes, audiotapes, or other activities may be used singly or combined. The feature set includes the medium for written information: chalkboards, whiteboards, or overhead projectors. It includes papers and reprints that you hand out to students; for some courses, these handouts may be very extensive.

Course features include office hours, and before, during and after class discussions both among students and between students and teachers. During these discussions, a common piece of paper or whiteboard helps share thoughts and ideas. Discussions may also be held via e-mail or telephone.

Review sessions may be held prior to quizzes or exams. Supplementary or enriching activities may be available for the students most interested in course topics. A variety of forms of assessment may be used: papers, discussions, quizzes, and exams.

Other features of the course include administrative details such as a roster and attendance information (especially at the K-12 level), seating plans, and gradebooks. At the end of the semester, grades for individual students are probably submitted to the administration and posted or sent to students.

Most of the courseware packages available include feature sets that support all or nearly all of these traditional course features. The principal difference, of course, is that you and your students need not be in the same country, let alone the same room. In fact, you may not even work concurrently, but asynchronously.

## Content Creation

Courseware tools make it possible for you to create the content-rich materials for your course without knowing anything about coding. Links between your syllabus and the calendar should be incorporated automatically into the materials you have created. Courseware usually will accept straight text and automatically encode it for HTML display. Most courseware also will accept HTML-encoded text, and is smart enough to know the difference.

## Online File Exchange

Trading papers with students over the Internet is something fraught with challenge. Even such simple tasks as attaching papers to e-mail often lead to misfires in communication. Effective courseware provides a means for facilitating these exchanges. Also, quality courseware permits teachers to comment on papers directly; teacher comments standout when the papers are returned to the student.

## Asynchronous Communication (threaded discussions)

Discussions where students can come and go are often thought to be a principal advantage of Web-teaching. One way to handle this is to create a **listserv**, an automatic electronic mailer wherein a person mailing to the list ends up mailing to all members of that list. All such e-mail is delivered to each member. An alternative is to form a news group. The principal difference is that users of news groups peruse titles of messages and choose which ones to download. In a listserv, subscribers receive each message and choose whether to read it. Also, they decide whether to keep or discard each message. In a news group, you might not download the message at all.

Courseware discussions are accessed across the Web; contributions are made through the Web. Good courseware keeps discussions organized according to **threads** and subthreads (Figure 3.02). A thread is a conversation theme. Contributors to the theme may choose to spin off sub themes. Participants also may create new threads. Using labels provided by the participants, the software places contributions into a hierarchical or threaded structure.

Teachers may choose to participate in the discussion, or to reserve them for students. We have heard reports of teachers participating using disguised names.

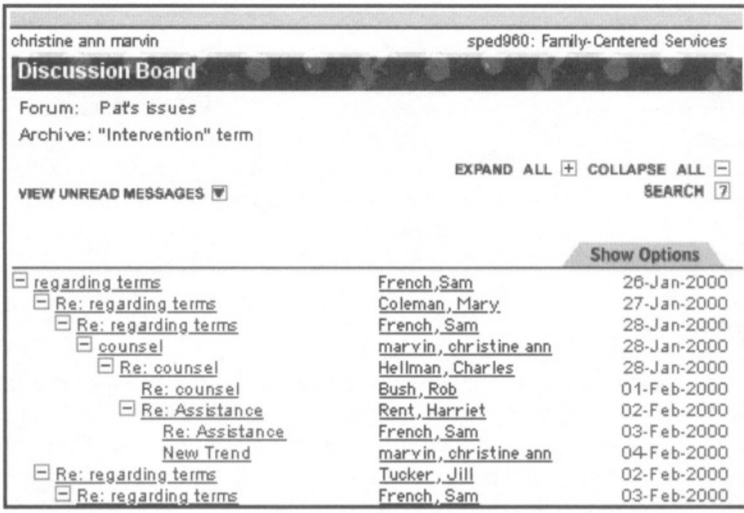



**Figure 3.02. Sample threaded discussion from Christine Ann Marvin's course, Family Centered Services.**

Web-based discussion connected with courses is the principal topic of Chapter 5.

## Synchronous Communication (Real-Time Chat)

Teachers value in-class discussions, and often see asynchronous discussions as deficient. In the Internet world, so-called chat-rooms have filled the need of those seeking real time exchanges. Courseware often includes synchronous communication features, known as chats.

## Whiteboards

Be it a blackboard, chalkboard, or whiteboard, classrooms nearly always have some means of sharing sketches and drawings. In modern classrooms, overhead projectors may have replaced the permanently mounted board of yesteryear. Whiteboards usually have variously colored, erasable markers.

Real-time sharing of electronic whiteboards between students and teachers is an Internet reality. By choosing different colors, the various contributors to the whiteboard may have their contributions identified. Whiteboards, often linked with chat-rooms, are becoming standard courseware features.

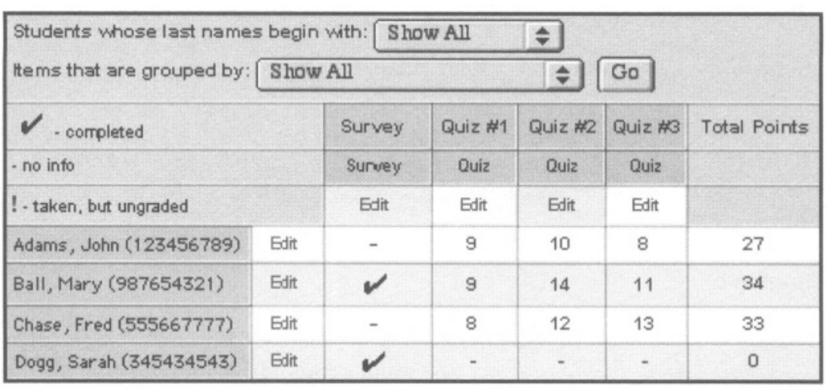
## Assessment Tools

Online assessment is becoming ever more important in Web-teaching, especially as teachers become more experienced with Web formats. Courseware products usually include some form of online testing. This testing can have many features. Access to tests can be controlled so students have only one opportunity to take each test. The tests can be timed. Several item formats are available for tests. This is likely to be an area where substantial improvements are made in the near future. Testing is discussed in Chapter 15.

## Gradebook

While teachers nearly always have some tools for helping them manage grades, from simple ledger books to sophisticated spreadsheet programs, they nearly always have crude methods for sharing information with their students. Spreadsheet printouts and lists of exam scores are still found in most high schools and colleges.

Courseware can provide a communication system such that students can see what their instructors have recorded in gradebooks. Courseware often has tools for grading, too, but these usually are not yet especially sophisticated.



Students whose last names begin with: Show All

Items that are grouped by: Show All Go

| ✔ - completed | | Survey | Quiz #1 | Quiz #2 | Quiz #3 | Total Points |
|---|---|---|---|---|---|---|
| - no info | | Survey | Quiz | Quiz | Quiz | |
| ! - taken, but ungraded | | Edit | Edit | Edit | Edit | |
| Adams, John (123456789) | Edit | - | 9 | 10 | 8 | 27 |
| Ball, Mary (987654321) | Edit | ✔ | 9 | 14 | 11 | 34 |
| Chase, Fred (555667777) | Edit | - | 8 | 12 | 13 | 33 |
| Dogg, Sarah (345434543) | Edit | ✔ | - | - | - | 0 |

Figure 3.03. **Modified screen capture of gradebook from a course managed using *CourseInfo*. Although the gradebook functions still are primitive, they remain very useful, especially for communications. This is a modified view of an instructor's screen. Students see only their own records.**

**Collaborative Work Groups**

Having students work together in groups where the tasks and roles are structured has been found to lead to small increases in student learning. In classroom settings, teachers often have students gather into smaller working groups within the classroom space. Sometimes the students wander, but rarely far away from the classroom. In distance settings, it can be even more difficult for students to meet in groups of three or four than to attend a traditional class. For this reason, courseware may have features that support the collaborative work of small groups.

**Messaging System**

Messaging systems allow for very quick communication between one Internet user and another. They are smaller than e-mail, but quite a bit faster, and use Internet features other than e-mail. Both Microsoft and America Online, Inc. have developed messaging systems. Courseware may have messaging as a built-in feature.

**Online Tutorial**

Students need to be trained in the use of the courseware. Courseware packages usually contain an online assessment of online skills, as well as tutorials to help students learn to use the courseware.

**User Tracking**

Teachers often suspect that students work less at their coursework than might be desired. Online tracking allows teachers to keep records about student use of courseware.

**Other Features**

Courseware may provide students the opportunity to create pages that bring together information from many sources. These can vary from current local weather to upcoming campus events. It works best when students can easily access all of their courseware courses at once, particularly with a single log-in.

The students in the courses sometimes are able to create informative home pages describing themselves. These can be both created and accessed through courseware.

## OTHER SUPPORT ISSUES

**The Bookstore or Book Room**. If you teach at the college level, students are expected to buy their own books, and your school probably is connected with a bookstore that offers textbooks for sale. If ordering books for student purchase is a part of the pre-course or early course activities, then having students use the Web for book purchase is becoming ever more common.

Many Web courses coming out provide all or nearly all of the written material required for a course. Also, there is an emerging type of course that provides hypertext links to other Web-based materials (Chapters 6, 8, 11, 15 and 16) that augment or replace the role originally served by textbooks.

**The Library**. Library usage becomes problematic when teaching on the Web. In many courses, especially post-secondary courses, use of a major library may be an integral part of the course. If the reading for a course is very specific, workarounds for library access may involve making materials available on the Web. (Remember to acquire the appropriate copyright permissions; see Chapter 19.) Alternatively, students may be able to use inter-library loan services for some materials.

**Advising.** For full-time students in degree programs, advising is almost always a part of the institutional offerings. Advising has tended to be very much a face-to-face, one-on-one activity. In the world of Web-teaching, advising changes; it enters the world of e-mails, messaging, and chats. Catalogs go online.

Programs of study, and even personalized schedules of courses, can be generated automatically for individual students using Web-based software provided by their institutions.

**Support Services.** For the on-campus student, colleges include a wide variety of support services. Support services include the student newspaper, financial aid office, placement office (including resumé and recruiting assistance), and even a medical center or school nurse. Many schools have already begun to make some of these services available online, especially financial aid services. Students who work full-time and take a Web course to avoid a three-hour drive each way probably do not seek much more in the line of support services. But, there are not yet many full-time Web students. As the number of Web students increases, the demand for support services also increases.

## EXAMPLES FROM COURSEWARE PACKAGES

### Courseware as a Mini-portal

The Web has encouraged selected providers to attempt to become **portal** sites – places where Web users routinely start their Web day. Providers of courseware see this as a strong possibility for them, as illustrated by this Blackboard screen at the University of Nebraska (Figure 3.04). Blackboard is continuing to develop an extensive management system, *Blackboard Campus.*


Figure 3.04. **Modified screen capture for the opening screen provided for David Brooks on April 2, 2000. Brooks has access to five courses: a trial course he created, a faculty discussion group, and three courses he visits as an observer.**

### UNL Electronic Course Catalog

At the University of Nebraska–Lincoln, a course catalog has been set up with a structure parallel to the traditional paper catalog (Figure 3.05). Many courses are listed, and the number grows each semester. Choosing a college leads to lists of departments. Choosing a department leads to lists of individual courses.

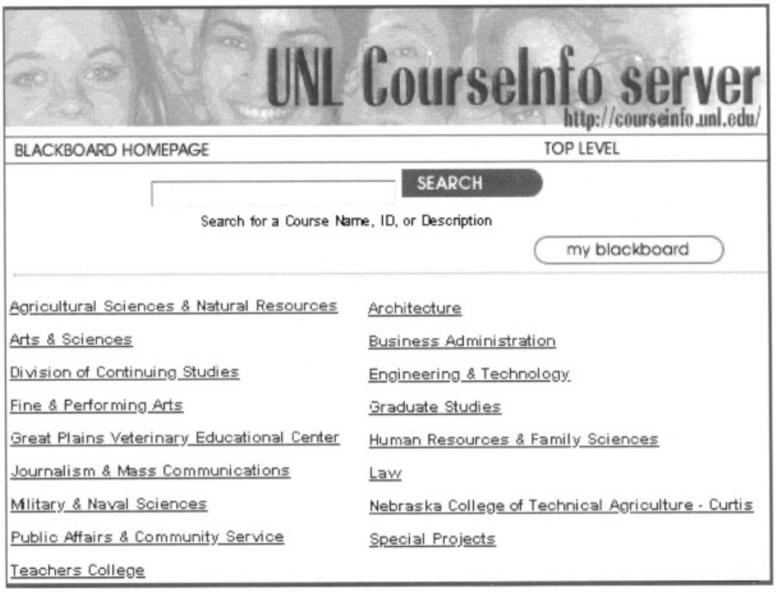



Figure 3.05. **Modified screen capture from top page of UNL electronic course list. Choosing one of these colleges brings up a listing of departments.**

## Student Tools

Each student has access to a set of tools. The tools in Figure 3.06, a standard subset, were issued for enrollment in a graduate statistics course.

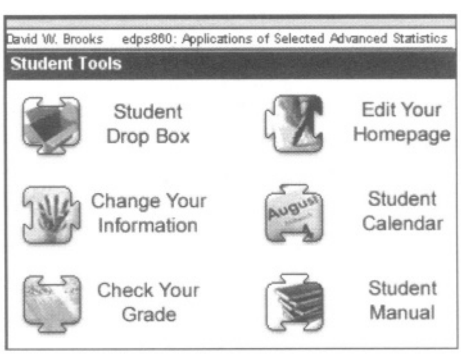



Figure 3.06. **Modified screen capture from student tools page. The student manual feature provides instruction for students about using *CourseInfo*. The student calendar can have entries made by course instructors.**

One menu choice is communication. This affords six options, one of which is e-mail. Choosing e-mail brings up a screen from which other options are given, as in Figure 3.07. For the instructor, this amounts to the same as having created several listservs.

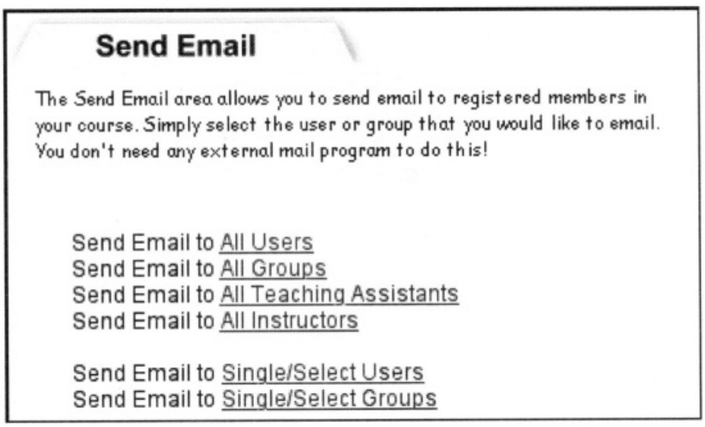



Figure 3.07. **Partial screen capture from e-mail options.**

Each student has the option of developing a personal page. Few students in this course took the opportunity to create personal pages. Threaded discussion was an option, too, as illustrated earlier in Figure 3.02. Students did avail themselves of this option. Most of the questions were technical; there was not much give and take. This is probably typical for statistics courses at this level.

## The IMS Project

IMS Global Learning Consortium, Inc., {U03.05} is a coalition of academic, commercial and government organizations, working together to define the Internet architecture for learning. IMS is short for instructional management systems. This initiative emerged from efforts at EDUCAUSE (then Educom).

> The scope for IMS specifications, broadly defined as "distributed learning," includes both online and off-line settings, taking place synchronously (real-time) or asynchronously. This means that the learning contexts benefiting from IMS specifications include Internet-specific environments (such as Web-based course management systems) as well as learning situations that involve off-line electronic resources (such as a learner accessing learning resources on a CD-ROM). The learners may be in a traditional educational environment (school classroom, university), in a

> corporate or government training setting, or at home. For example, the IMS Learning Resources Meta-data Specification (www.imsproject.org/metadata), benefits the learner looking for information with a meta-data aware search tool both when the search is of Web-based resources and when she or he is searching through a CD-ROM or DVD-ROM encyclopedia in their computer at home. Content developers who have implemented the IMS Learning Resources Meta-data Specification will have made it much easier for the people doing the search to find the resources they want in a much more efficient way, since meta-data allows users to be much more specific in the search terms they can specify.
>
> IMS Global Learning Consortium, Inc., {U03.05}

As of this writing, it is not clear how much impact the IMS Project will have.

## INFORMAL OBSERVATION ABOUT USAGE

When inquiries are made among faculty about the use of course management software, it does not surprise us that most of the features available to faculty go unused. As with many powerful software packages, the available feature set exceeds the feature set actually used by most users.

## GLOSSARY

courseware (course management software): computer software designed to support the activities normally incorporated by a teacher in an online course.

feature set: in software jargon, a set of operations provided in a particular software package. For example, browser software is expected to include making, editing, and displaying bookmarks as part of its feature set.

listserv: an automatic mailing system such that, when someone sends mail to the system, a copy is transmitted to all subscribers.

portal: a Web site or service that offers a broad array of resources and services, such as e-mail, news, weather, forums, search engines, and online shopping malls. Most of the traditional search engines, such as Yahoo, have transformed themselves into Web portals. Courseware providers are seeking to establish themselves as portal sites. They have interests in two portal strategies: one for students, and the other for faculty as researchers.

thread: in Web-based discussions, a way of linking contributions (posts) which address the same or closely related topics. Responses to the original post are automatically linked to it.

Web site: server that serves the Web. Usually indicates a net location from which a substantial amount of related information is served.

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Seymour, L. (2000). Giving the Web the new college try. *Washington Post.* March 28, p. A11.

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# CHAPTER 4

# Students and Web Use: Expectations

Do you include your office telephone number in your syllabus? If so, do you give instructions on how to use a telephone? Certainly not, your students come to class with that knowledge.

What does a teacher have a right to expect about prior Web use by students? Let's turn the tables a bit. Have you

- purchased a book over the Web?
- e-mailed an electronic greeting card to a friend?
- published a research paper that has included a URL among the bibliographic references?
- created a Web page with HTML tags?

It is extremely unlikely you purchased a book over the Internet in 1990. To do this you would have needed to e-mail a friend, ask them to get the book for you, send a check, and wait for the friend to purchase the book and send it to you. You could not use a browser to find the book on the Web and make a one-click purchase. Browsers, as we know them, did not exist; there were no companies in the business of selling books over the Web, and there was no one-click purchasing of anything. The Web was still in its infancy.

Because the world is in a state of transition with respect to Web use, you probably have no idea about what your students really can do using the Web. They may have little or no experience, but it is very likely they will have some or even a great deal of experience. As we go forward into the year 2000, it will be ever more difficult to find a student who has not made a Web-based purchase. You may be surprised, perhaps shocked, at just how much Internet

experience some students already have. They may be highly skilled at downloading music, for example.

It is very possible, however, to vastly overestimate your students' abilities to utilize powerful software. Runge et al. [1999] found that substantial amounts of classroom time needed to be devoted to teaching students the specifics of manipulating symbolic mathematics software when such packages were used in physics courses.

## METACOGNITION

Metacognition {U04.01} is defined as knowing how we think and learn. This is usually broken down into two parts. One part deals with what we know about how we think and learn. The other deals with how we make use of that knowledge (self-regulation). Included in knowing what we know is procedural knowledge (what we know about making things happen) and conditional knowledge (when do these rules apply).

There will emerge a metacognition about Web use. It will emerge over time, but it will get to a point where most folks know how to use the Web in the same way that they know how to use a telephone. They may well have to use the Web if it replaces the telephone as we know it today – a serious, world-wide possibility.

## TEACHING STRATEGIES

When teaching a Web course during the early 21st century, the burden of making sure that your students are Web worthy may fall on your shoulders. Experience has shown this is a very real, pragmatic teaching issue [Runge et al., 1999].

We see three approaches to this problem. The first approach is to assume that there is no problem. That is, assume your students have all the Web knowledge they will require for your course. Should you choose this approach, proceed at your own peril.

The second approach is to insist that students meet certain minimum standards, and use these as prerequisites to course registration. There are several ways to handle this. One is to put institution-wide training and testing programs in place, and to have all students prepare using this option. Web-courses offered by UCLA use a standard courseware package (*Embanet,* {U04.02}, formerly *FirstClass*), and require all students complete an orientation. If students do not complete the orientation within a specified period of time, students are dropped from the course, and their tuition is refunded (minus a minor fee for the

orientation). Once the orientation has been completed, both the orientation and the fee for it are waived for all future courses.

The issue of sufficient training is no small matter. We know of distance courses where faculty were poorly trained. Although students were completing assignments and submitting them regularly early in the courses, the faculty were unaware of the students' efforts. The faculty mistakenly began toning down their expectations through revised assignments. Proper training is necessary for everyone, students and faculty alike. Getting everyone up to speed early in the game is essential for success.

One of the biggest Web-teaching problems is that students try to take a course when they really don't have the necessary hardware or software. In 1995, we taught a course that used a CD-ROM for core content. Although it was made clear up front that students would need to access a Macintosh computer capable of playing CD-ROMs, students without CD-ROM access attempted to complete the course. As of this writing, some **Internet Service Providers (ISPs)** still use browser software which is incompatible with some interactive aspects of Web-teaching. Speed and cost of access for students may also become factors for consideration.

The third approach to assuring your students are Web worthy is to undertake teaching the basics of Web use yourself. Parts of this may be essential. For example, if your course deals with using *Mathematica* (powerful symbolic mathematics software), there will be some specifics that you'll need to cover for yourself. In chemistry teaching, you'll need to handle subscripts and superscripts. In many languages, Czech to cite an example, you'll need to decide upon ways to create and exchange language symbols. These problems are not easy, and they will fall on your doorstep as a teacher. As for the everyday logging on, bookmarking, using forms and text fields and radio buttons, using pull-down menus, and the like, we recommend that you offload all teaching and certification of performance in these areas if possible. In case you must train your students to use the Web, we provide some suggestions below to stress in your teaching.

Remember, if you choose the third option, initial Web access of course materials may not be possible for your students. We have two suggestions regarding strategies you might employ. If you are in an entirely distance setting (i.e., your students never come to a campus), consider mailing print and possibly video materials to help students get started. The other strategy is to offer telephone help at the beginning of the course. This often is not very helpful. Many home users have a single telephone line. They can talk to you, or connect to an Internet service provider via modem. They cannot do both concurrently. Novices often require coaching as they work through Web screens.

## TIPS TO TEACH

Even students who have experience using the Web may need a few pointers. Be careful with the use of technical terminology. Words as simple as browser may be foreign even to students who use the Web all the time. Define all terms that might be unknown. A few specific questions you may want to address:

*Is my computer working or has it "frozen" and what do I do about it?*

One of the hardest things for neophytes, and sometimes for old-timers, is to figure out whether the computer or the browser is working or has become frozen (stuck). If students believe their machine is frozen, several clues exist. If the mouse cursor (the arrow or hand) will not move at all, first check to see that all connections are secure. If they are, the computer is frozen. If the cursor moves, the individual program may still be frozen. Possibly the most important thing to tell students is to take their hand off the mouse and examine the screen. Do not click on the mouse. If the computer is working, sending multiple mouse clicks will slow the process further; if it is frozen, the multiple clicks are useless.

In most browsers subtle hints are given to indicate processes: messages appear in the bar at the bottom of the window, or icons strobe or move (the current version of *Communicator* runs flying comets in the Netscape icon). Students should be encouraged to watch for these indicators as they use their browsers so they become familiar with them.

Computers usually have a small light near the disk drive that blinks as the drive is accessed. If the light is blinking, the computer is trying to process.

In most cases, if any of these clues is active (icons strobing, words changing, or lights flashing), the machine is most likely working, not frozen. However, occasionally even a frozen computer will appear to be working.

If the individual program may be frozen, try switching between programs. On a PC, try holding down Alt and pressing the Tab key to alternate which program you are using. On a Mac, use the Application Menu in the top right corner of the screen.

When the computer appears to freeze, there are some basic steps to use. Check for response from the mouse cursor. Examine the screen looking for the subtle clues. Walk away for a few minutes; sometimes computers take an unusual length of time to process something.

If none of the clues are active and the computer is still not responding, it may be necessary to force the computer to quit an application by using the "three-finger-salute". On most PCs, this requires holding the Ctrl, Alt, and Del keys all down at the same time. On some Macintoshes, restarting requires that a paperclip be inserted into a small hole. Sometimes the only way to restart is to pull the power plug or, on a PowerBook, remove the battery! On a PC, the salute

causes a Close Program dialog box to appear; execute an End Task on any programs that are not responding by following the directions in the box.

If the "three finger-salute" does not work, it is time to hit the reset button or turn the computer off at the switch.

*Why does it take so long to access this page?*

Several factors influence the length of time needed to download a page. The speed of the local computer and the local connection both will affect the speed of download. But the main culprit for slow downloads may be increasingly heavy Net traffic. If the connection must first go through a local network, like a university system, the congestion on that network may display very distinct patterns of usage. When the connection gets past the local network, it must deal with both the general Internet traffic and whatever local network traffic may exist on the distant server.

Finally, the major slow down may have its roots in the design of the page being loaded. If the page contains a large amount of artwork, pictures, background art, movies, or sound files, the download is drastically slowed. In general, the larger and more complex the page, the slower the download.

If the page seems to be taking an inordinately long time to download, especially if you know it should not, occasionally it may be worthwhile to stop the download and restart it. But if it is the first time a page has been downloaded, it is best to wait for the download to timeout before restarting it.

*Why can't I reach this site?*

Being unable to reach a particular site can be very frustrating to students. The Web is not static. Sites move between different machines, disappear, or are reorganized. URLs are changed, and computers go offline. With the dynamic nature of the Web, finding **broken links** or sites that are not reachable is common. Students need to understand that there are many reasons they may not be able to reach a site. It may be a simple matter of trying to reach the site again, right away, later the same day, or on a different day. If network computers are sending information that the URL does not exist, first check that it is typed correctly. Then look for "obvious" problems like a space in the name. If neither helps, try deleting information from the end of the URL, back to the first slash, and hit enter. If this still does not work, continue deleting to each slash and checking each smaller URL. It may be necessary to perform a search to find the site's new location. In some cases, the site may have been removed.

*How long is this document?*

Documents on the Web, even if they are only a single Web page, can be several printed pages long. Many, but not all, modern browsers have a subtle clue to the length of the document; the smaller the scroll box in the scroll bar, the longer the document. Another way to determine the length is to execute a print preview and check how many pages are involved. Beware, a print preview that shows a document's length may not translate into a document of that size when printed. Some documents, by accident or design, either print in very small print or execute page breaks more frequently than the preview indicates.

*Can I get back to this document?*

Students need to know how to bookmark sites, how to access their bookmarks, and how to use the Back Button. Bookmarks (or Favorites in *Internet Explorer*) are a quick way to note a page's location. By adding a bookmark, the student has an easy way to return to a page later. Students need to understand the limitations of bookmarks. Bookmarks can't be used to return to pages calculated by programs or to pages created during searches. Students can save the file to disk for later reference if they are working on their own machines, but they need to be aware that, while the file is saved, the URL usually is not saved. Any images or other multimedia files also must be saved. Another way to save locations is to copy the link and paste it into a document.

*Bookmark management*

Encourage students to create folders within their bookmark (favorites) folders to help keep their bookmarks organized. Students should use their browser's help files to learn how to make new folders and organize bookmarks.

## SEARCHING THE WEB

The Web is a remarkably powerful tool for finding information. Not all information is on the Web, but it is remarkable how many teachers, organizations, and individuals have been creating Web pages rich with discipline-specific content. The accuracy of available information in traditional sources always has been a problem; books and journals often contain errors. This book, for example, may contain errors of fact. This is in spite of the best intentions of the authors, and the editing procedures used by a highly reputable scientific publisher. For Web-teaching in particular, new information becomes available at a remarkable rate. As of this writing, in our second edition, we have seen the completion of less than a single decade of Web-teaching experience.

If there is a problem with the quality of information garnered from conventional publishing sources, then that problem is far worse on the Web. The majority of the Web is not subject to review. There are few editors or monitoring organizations, and there are no established mechanisms to remove incorrect or inappropriate information. In principle, anyone can post anything. Education is a discipline subject to fads and whims, and many sites are disseminating information of dubious quality.

On the other hand, nearly every educated person we know who has received a diagnosis of a serious disease at the end of the 20th century has looked to the Web for current information and support. At least three types of information are available. There is technical information about the specifics of the disease. Web-based support groups provide both practical information and emotional support. Finally, there information about clinical trials where disease victims can learn about access to experimental protocols. Some trials include online application materials for prospective participants. The Internet has increased information resources for patients, and changed their conversations with physicians.

Given the variety of types and the quantity of information available on the Web, it is appropriate that a course include the use of Web-searches by your students. Because of this, consider requiring one or two structured Web-based searching assignments early in your sequence of assignments.

**Searching Strategies**

The best way to learn how to search for information on the Web is to use the Web itself. A **search engine** is a large database made available over the Web. Search engines use automatic software programs called "**bots**, **crawlers**, or **spiders"** to discover and categorize information residing on the Web.

Search engines may be accessed, and the desired information sought through the use of key words and **Boolean** operators. Google {U04.03} is a basic search engine. Most search engines now include either the use of directories or **meta-searches**. A meta-search involves accessing several smaller engines at the same time. Dogpile {U04.04} and MetaCrawler {U04.05} are examples of meta-search engines. For example, using Dogpile includes a search of Google. **Subject directories** group Web sites together using extensive subject classification schemes. Yahoo! {U04.06}, Alta Vista {U04.07}, and Excite {U04.08} are examples of subject directories. Greg Notess {U04.09} provides an in-depth comparison of search engines, including special features and methods for searching.

Still another approach is that of *Sherlock* {U04.10}, software created by Apple. Plug-ins specific to search engines put *Sherlock* in touch with databases. In a sense, *Sherlock* permits each user to create one or several meta-search engines.

As of this writing, the source of revenue that supports these powerful Web-searching tools is the advertising which each displays. Some have become portals, sites users typically set as browser home pages. The idea is for the user to use this site routinely to start their work or play on the Web. These sites can be personalized, and provide user-specific information. For example, one of us uses My Yahoo! {U04.11} as a home page, and receives daily weather information from places where family members live, selected news, stock information, and air fares to several Hawaiian destinations from nearby major cities.

Library gateways and specialized databases also are available. ERIC {U04.12}, the Educational Resources Information Center, is a database serving educators. The prestigious Chemical Abstracts Service (CAS) {U04.13}, a systematic abstracting service, is available online.

Information searching is both a very dynamic and an important area. As information needs become more specialized, we can expect to see fee-based sites such as CAS proliferating. In addition, we can expect to see improvements in the software tools that crawl around the Web seeking out information. The amount of information on the Web has become so vast that it is hard to imagine being able to search all of it successfully. Broken links, URLs that no longer function, are commonplace – even in search engines.

The University of South Carolina {U04.14} and The University of California–Berkeley {U04.15} have excellent sites describing the Web searching process. Each provides insights to developing successful strategies. Web searching assignments have become integrated into library orientation courses. For two good online examples, see Louisiana State University {U04.16} and the Kelliher site at Goucher College {U04.17}.

## GLOSSARY

Boolean: a system developed by mathematician George Boole, logical variables are represented by the digits 0 (false) and 1 (true). A Boolean expression evaluates to true or false. Consider the expression *A* AND *B*. In this scheme of logic, for the expression to be true, both *A* and *B* must be true. The Boolean logic operators are AND, OR, NOT, NAND, NOR, and XOR. For OR to be true, *A* can be true, *B* can be true, or both *A* and *B* can be true. For NOR to be true, neither *A* nor *B* can be true. For NAND to be true either *A* or *B* must be true, or neither can be true, but both cannot be true at the same time. For XOR to be true, either *A* or *B* must be true, but both cannot be true. Booleans are used extensively in computer programming. Boolean expressions are used widely in Web searches.

bot: short for robot or “knowbot.” Also called crawlers and spiders. A search program, sometimes called a software agent. Bots search multiple sites simultaneously, can eliminate dead links, can download pages, use sophisticated search refinement, and can generate reports.

broken link: Web pages tend to be dynamic and often are revised, removed, or relocated. The links in one page that tie to another, especially between different sites, are not automatically updated. Broken links are the result. When a broken link is clicked an error message such as “file not found” or “Error 404” results.

crawler: see bot.

Internet Service Providers (ISPs): in the United States, access to the Internet is nearly always provided by commercial sources. Universities pay for this access, as do individuals. Cost and speed of access become issues for students.

meta-search: search the databases of multiple sets of individual search engines simultaneously from the same place and from the same screen. They provide a rapid means for deciding which search engines merit wider attention.

search engine: search engines are huge databases. They contain URLs for Web pages. Search engines compile their databases by using software agents (programs called bots, crawlers, or spiders) to crawl through Web space from link to link, identifying and perusing pages. Bots often index most of the words on the publicly available pages at the site. Search engines, actually search through a database using keywords and phrases, and differ in size, speed, and content. No two search engines use exactly the same ranking schemes, and not every search engine offers exactly the same search options. Search engines use rules to rank pages. No two search engines are identical. Because the Web is a dynamic environment, similar searches performed hours apart may give markedly different results, especially when current events are searched.

spider: see bot.

subject directory: directories are edited by experts. They are organized into hierarchical subject categories, and sometimes annotated with descriptions. They do not have access to full-text documents. Only subject categories and descriptions may be searched. An example is Yahoo! {U04.06}.

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U04.04. Dogpile, http://www.dogpile.com/ (accessed 4/5/00).
U04.05. Metacrawler, http://www.metacrawler.com/index.html (accessed 4/5/00).
U04.06. Yahoo!, http://www.yahoo.com/ (accessed 4/5/00).
U04.07. Alta Vista, http://www.altavista.com (accessed 4/5/00).
U04.08. Excite, http://www.excite.com/ (accessed 4/5/00).
U04.09. Search Engine Showdown: The Users' Guide into Web Searching, http://searchengineshowdown.com/ (accessed 4/5/00).
U04.10. Sherlock (Apple), http://www.apple.com/sherlock/ (accessed 4/5/00).
U04.11. My Yahoo!, http://my.yahoo.com/ (accessed 4/5/00).
U04.12. Educational Resources Access Center, http://www.accesseric.org/ (accessed 4/5/00).
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# CHAPTER 5

# Encouraging Discussion

An important decision for you to make when designing a course is, "What role will discussion play, if any?" This chapter deals with issues related to Web-based discussions. First, we address the nature of online discussion and the research support currently available related to it. Next, we address strategies that a teacher may use to encourage Web-based discussion. Finally, we discuss the types of software that may be required to support Web-based discussion.

## THE NATURE OF WEB-BASED DISCUSSION

Student discussion in any course, regardless of the delivery format, is essential in allowing students to question and process the new knowledge they are acquiring. Discussion also allows students to exchange ideas and perspectives about the meaning and future application of the course information.

We divide the instructional design tasks with respect to student interaction into two major areas: discussion (this chapter), and responding to questions (addressed in Chapters 7, 14, 15, & 16).

Teachers of subjects that involve extensive classroom discussion often imagine to be mainly a one-way dissemination of content. But in practice, most of the early uses of the Internet for teaching have emphasized electronic discussions: teacher-student discussion, student-student discussion, and/or student-expert (outside resource person) discussion. In the final evaluation of a seminar course that employed online discussion features, students reported working 40 to 50 percent longer outside of class than the average college course, and 31 of the 32 students reported learning more from courses that included online discussion formats [Greenlaw, 1999]. Karayan & Crowe [1997] report that students are more likely to "exhibit desired behaviors" as a result of

participating in electronic discussions. Powers & Mitchell [1997] report a qualitative study of an Internet-delivered graduate course in which four themes emerged: student peer support, student-to-student interaction, faculty-to-student interaction, and time demands of the course.

Because of very positive learning outcomes, we perceive important face validity in trying to support Web discussion. In traditional classrooms, discussion is mostly talk; on the Web, it's mostly text. Thinking explicitly about discussion is an important design issue for prospective Web teachers.

The first edition of *Web-Teaching* indicated that some issues might be too laden with values and emotions to deliver via Web instruction. That initial impression may have been too conservative. Dr. Christine Marvin taught a course {U05.01} dealing with family centered services for children with disabilities over the Web, and the results were very promising. The boundaries of what does and does not work in terms of Web-based discussions remain to be established.

## Asynchronous versus Synchronous Discussions

In a Web-based environment, discussion takes one of two general forms. The Web is very useful for **asynchronous discussion**, however, new software is quickly evolving to reduce the complexity of several different **synchronous discussion** (chat) formats. Asynchronous discussions on the Internet have been used for a number of years through bulletin board systems (BBS) and **listservs**. Bulletin boards have evolved into discussion forums, software that creates an environment where users post and read messages on their own schedule.


Figure 5.01. **Example of a Web discussion forum (Calculus reform).**

Forum systems often allow for HTML coding to be used in addition to text. This, in turn, empowers the user to post URLs and images as part of the active discussion. Users log on at their convenience to participate, without a scheduled "class meeting" time. This format allows the user the most flexibility. If you adopt a Web-course management software package (*CourseInfo, WebCT*, etc.), usually you'll find support for both types of discussion incorporated.

You should decide whether an asynchronous or a synchronous discussion format best meets your instructional needs. Synchronous discussion requires scheduling for all members of the class to participate online at the same time. Synchronous strategies can be used by requiring small groups to be online at the same time, or for online office hours when the instructor is available for discussions. You may require simultaneous participation from your students. Most modern courseware packages have the ability to include chats. When choosing synchronous versus asynchronous discussions, consider these implications:

- What is the purpose of the discussion?
- Will participation be required?
- Will participation be graded?
- Are my students online because of distance or time restrictions?
- Are synchronous discussions critical to success?
- Will students have a choice of when to participate?
- Will participation be assessed?
- Will a certain number of postings be required per topic? Per week?
- At what level(s) during the discussion will students be required to participate?

Understanding the differences and implications of using each format will help you to choose the better format for your course discussions. If all students are required to respond to each question posted by the instructor, is it really a "discussion" or is it more of a question and answer format?

Prior to setting student participation requirements, estimate the time necessary for supervision and assessment of that participation. The topic posted by the instructor is considered the "root" level of a thread or topic. If every student in a class with 25 students had to reply at the root level and at least one other level, the instructor would be required to read at least 50 postings or messages for each posted question. Experience tells us that it is always more than that. In order to keep some control over the workload of reading class discussions, it is essential that you plan ahead regarding the requirements for participation given to your students. Some of our colleagues have incorporated every available interactive Web discussion component into a course. Their success has varied. Even the slickest discussion features have turned out to be

worthless as a course activity, or a "monster" in terms of instructor workload if not well thought out in advance.

Be sure that the features you choose match the design and function of your course. Students often tend to do what is required, but not much more. Therefore, to promote class discussion in an online course, you'll have to do more than suggest that students participate in the discussion forum. You'll need to require it.

In a face-to-face educational setting, discussion is used to assess student understanding of the content, or to answer student questions. In cases where the content is factual, the first correct student response ends the discussion. Therefore, Web questions that require analysis, synthesis, evaluation, or application are more likely to produce extended discussion.

### Examples of Web Discussion

Technically speaking, when considering digital strategies, discussion is easier to accomplish than is interactive content dissemination. For discussion, what matters most to the teacher is not what is done with the Web server, but how one designs learning activities. Two examples of recent discussions held in classes on our campus are shown. The first came in response to a mathematics question posed in an upper-division/graduate course, and the second as a response in a lower-division history course:

**Question:** A subset $A$ of the metric space $X$ is called *path connected* if, given any two points $x, y \in X$, a continuous function $\gamma : [0,1] \to X$ can always be found such that (i) $\gamma(t) \in A$ for all $0 \leq t \leq 1$, (ii) $\gamma(0) = x$, and (iii) $\gamma(1) = y$. The map $\gamma$ is called a *path* from $x$ to $y$.

1. Prove that the disk $\{z \in \mathbb{C} \ |z| \leq 1\}$ is path connected. (A picture would help your proof, and I'll be impressed if you can post it!)
2. Prove that a path connected set is connected.

**Figure 5.02. Question posed in John Orr's graduate mathematics course in analysis. To avoid formatting problems, early versions of this discussion system involved creating gif images of the questions.**

*Student Response:*

To prove that the unit disk is path-connected just draw a segment of radius joining the origin with both points. Then the path consisting of these two segments connects these two points and of course lies inside the unit circle. A path-connected set is connected, since otherwise preimages of open sets disconnecting A also would be disconnected open subsets of 0,1 and since the interval 0,1 is connected there must be a point belonging to the interval 0,1 which is also in neither of preimages. That contradicts to the fact that the path lies entirely inside the set.

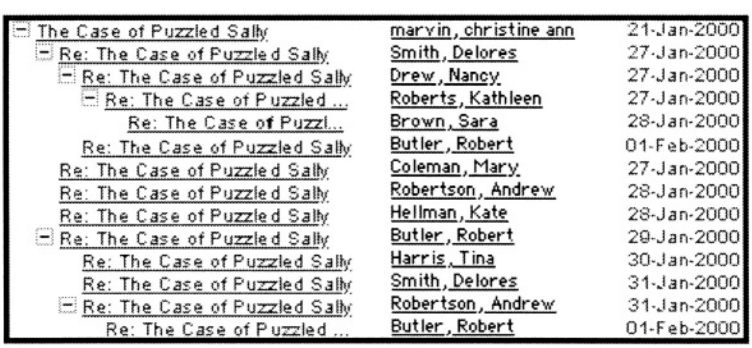
*Teacher Question:*

In class, I'd like us to take a close look at John Eliot's constructed dialogue between a converted Indian and his unconverted relatives (2:1). How much does this document reflect Eliot's perceptions, and how much does it reflect Indians' perceptions?

*One of several student responses:*

I also believe that Eliot's account is mostly of his own creation. He portrays the unconverted Indians as almost comical in their ignorance. In Eliot's account, they are concerned with nothing but eating, drinking, and being merry, when in fact, most Indians had a very meaningful spiritual life. The converted Indian in this account is also less than realistic. He visits relatives living in his former village, yet he seems completely withdrawn and detached from their way of life.

Course management software for the Web nearly always includes schemes for supporting asynchronous discussion. Figure 5.03 illustrates a section taken from a planned discussion in a course on Family Centered Services.



| | | |
|---|---|---|
| The Case of Puzzled Sally | marvin, christine ann | 21-Jan-2000 |
| Re: The Case of Puzzled Sally | Smith, Delores | 27-Jan-2000 |
| Re: The Case of Puzzled Sally | Drew, Nancy | 27-Jan-2000 |
| Re: The Case of Puzzled ... | Roberts, Kathleen | 27-Jan-2000 |
| Re: The Case of Puzzl... | Brown, Sara | 28-Jan-2000 |
| Re: The Case of Puzzled Sally | Butler, Robert | 01-Feb-2000 |
| Re: The Case of Puzzled Sally | Coleman, Mary | 27-Jan-2000 |
| Re: The Case of Puzzled Sally | Robertson, Andrew | 28-Jan-2000 |
| Re: The Case of Puzzled Sally | Hellman, Kate | 28-Jan-2000 |
| Re: The Case of Puzzled Sally | Butler, Robert | 29-Jan-2000 |
| Re: The Case of Puzzled Sally | Harris, Tina | 30-Jan-2000 |
| Re: The Case of Puzzled Sally | Smith, Delores | 31-Jan-2000 |
| Re: The Case of Puzzled Sally | Robertson, Andrew | 31-Jan-2000 |
| Re: The Case of Puzzled ... | Butler, Robert | 01-Feb-2000 |

**Figure 5.03. Sample discussion from course on Family Centered Services taken from *CourseInfo* software by Blackboard.com.**

## STRATEGIES FOR WEB-BASED DISCUSSION

Student collaboration does not happen automatically. It must be purposefully designed into activities and assignments in the course [Palloff & Pratt, 1999].

Rossman [1999, {U05.02}] concludes that learners value and learn from the responses of other students. Keeping current in the discussion is important for the good of the group; requiring regular participation is essential. As with traditional face-to-face instruction, students benefit from formative as well as summative feedback in online courses. Discussions allow teachers to post information and responses for the entire group to read rather than requiring an individual response to each student in the course. Designing strategies that provide feedback and interactions with other students will help prevent the course from becoming overwhelming in terms of the workload for the instructor.

There is evidence of some learners feeling isolated and non-connected during online courses [Garson, 1999]. While online learning may not be the format of choice for everyone, a good course design that insures a high level of interaction will alleviate some of these issues [McVay, 1998 {U05.03}].

### Cooperative Learning

Many innovations in education are discarded as fads. Cooperative learning {U05.04} is a strategy with strong research support [Ellis & Fouts, 1993]. It is likely to stick. A recent meta-analysis of the use of small groups in undergraduate science, mathematics, engineering and technology education [Springer et al., 1999] suggested a favorable average effect size of 0.5 standard deviations. There is a great deal of effort in developing cooperative learning strategies for use in higher education [Millis & Cottell, 1998]. Specific suggestions for using cooperative learning strategies have been compiled for several disciplines, as exemplified by the work of Nurrenbern [1995] in chemistry. In cooperative learning, several features recur among descriptions of best practice:

- small (2-5 member) groups
- task suitable for groupwork
- positive interdependence (cooperation necessary for success)
- individual accountability
- learning time devoted to interpersonal/cooperative skill building
- teacher serves as guide

Just by using e-mail and group e-mailing addresses where three or four students easily can e-mail to one another, teachers can create very successful groups.

While revising this book, we "chatted" with many researchers named herein via e-mail. That's an example of cooperative learning! Students can use e-mail in the same way.

The nature of the design of a cooperative learning assignment in an online course requires the instructor to think about the issue of synchronous versus asynchronous participation in the course. A variety of strategies are available for establishing structure for cooperative learning [Klein & Pridemore, 1994]. Deadlines for the completion of tasks and discussions in the small group need to be well-defined and enforced. Learners become frustrated quickly if they feel another member of their cooperative learning group isn't participating on the same timetable as everyone else.

In a qualitative study of an online course for high school chemistry teachers, cooperative learning was identified as one of the most powerful features [Liu, 1996 {U05.05}]. The instructor facilitated this by creating a listserv at the outset, and made the first assignment on the listserv be "introducing yourself." All the participants were chemistry teachers, and most K-12 teachers know about cooperative learning.

Effective cooperative learning demands considerable teacher planning. There is no assurance that a strategy that works face-to-face will work over the Web. If you are new to cooperative learning, find someone who uses cooperative learning to teach the same content and level that you teach, and discuss your plans. In other words, seek an experienced mentor for developing cooperative learning strategies, preferably one who has been successful in your discipline and with students similar to your own. Plan your Web-based approaches after those conversations. A very good place to find collaborators is on the Web itself. There are ongoing teacher discussion groups for nearly all disciplines.

> Attention to instructional design is one of the most critical factors in successful learning networks, whether course activity is delivered totally or partially online or in adjunct mode. All education, on a network or in a face-to-face environment, involves intervention by an expert (the instructor) to organize the content, sequence the instructional activities, structure task and group interaction, and evaluate the process.
>
> Harasim et al., 1995, p. 125

Videoconferencing between students may yet become a major means for accomplishing cooperative learning. Students already have discovered that e-mail is an effective alternative to telephone conversations.

### Shared Tasks and Projects

Creating shared tasks or projects as a course requirement fosters student-to-student discussion. Collaboration can be easily supported by designing activities for students that involve researching and communicating over the Web. A course taught at the University of Missouri-Columbia recently paired students with students from another university to work collaboratively on the same task as a "virtual team" [Ludwig, 1999]. The students had access to a variety of Web-based communication tools, but used e-mail almost exclusively to complete the task. A course listserv was utilized for student discussion. Another variation on the theme is to assign a task to a team of students, and pair them with student teams from another location who have worked on the same task. They can compare perspectives and the differences in issues as they complete their projects [Hurley et al., 1999]. Both of these strategies are designed to foster exchanges of information between students rather than between the instructor and the students. In the case of geography, this is a valuable strategy in comparing the same issue from the perspective of different locations. The same case might also be made for a number of additional areas of study including the sciences and social sciences.

### Peer Review and Comment

In teaching writing, one former colleague had his students publish all of their writing on the Web. They signed releases at the beginning of the course, and then again at the end to permit maintaining their contributions on the Web. They published anonymously. A system enabled students to send and receive e-mail anonymously. The Web publishing and anonymous electronic commenting seem to enhance student learning. Many courses in a variety of disciplines require that student papers be posted, and that students review at least a few of their colleagues' postings. A strategy aimed specifically at improving writing skills, Calibrated Peer Review® {U05.06}, is described in Chapter 16.

### Student Led Discussions

Students usually respond to the instructor with what they feel is the "correct" or "desired" response. They are not likely to question or contradict a posting to the discussion by the instructor. This can sometimes stifle discussion where it might be most valuable to the students. While monitoring online discussion, take advantage of students who might have differing opinions to encourage student discussion on a course topic. Assigning discussion topics to the students, therefore, is another strategy that can be used to encourage Web-based discussions. Students often are good at relating their own understanding of

a topic, and other students in the course are much more likely to question or argue another point of view among their peers than with the instructor.

Student led discussions often generate "this is what it means to me" responses. These are valuable in helping learners process the new information.

### Using a Taxonomy of Questioning

Bloom's Taxonomy [Bloom et al., 1956] creates a hierarchical structure for cognitive tasks. It has been used as a basis for hierarchical levels of classroom questioning. Questioning at several levels is important. Web discussion questions should require learners to apply, analyze, synthesize, or evaluate the course content; questions should require the student to process information and to explain meaning. Carefully designed questions intended to elicit on-topic discussion will be more effective for Web discussions and will keep the discussion from rambling off-topic and out of control [Beaudin, 1999 {U05.07}].

### Problem-Based Learning

Problem-Based Learning {U05.08} "is a process by which the content and methods of a discipline are learned in an environment in which they are to be used to address a problem." Most implementations of problem-based learning incorporate cooperative learning strategies. Web-supported problem-based learning is used by Judith Poë in a large general chemistry course at the University of Toronto. Recently she assigned students to one of two problems, "Aluminum" {U05.09} or "Titanium" {U05.10}. She maintained an asynchronous discussion, for each problem (under the heading "chat"). Not all students visited the site to contribute, and fewer contributed more than once to the three-week-long, ongoing discussion. The average number of visits per student was over ten, however, providing strong evidence that students used the site. A visit to the published discussions suggests that, as students found information addressing "the problem," they shared this with others electronically.

Engaging students in solving real, open-ended problems is a very powerful strategy for learning. Making this into a reality for large courses such as introductory general chemistry is an enormous challenge for teachers. The importance of Poë's work lies not just in the attempt to incorporate cooperative learning activities systematically within an intellectually demanding, large enrollment lecture course, but also in the care with which she has documented student learning in this environment.

## SUPPORTING WEB DISCUSSION

If you intend to have discussion at a distance or over time, you'll need some ideas about managing the related technology.

### E-mail: Simple and Effective

Teachers probably should be using e-mail in all courses whether or not they have a presence on the Web. E-mail can become the principal tool for maintaining interactions between students and teachers in many settings. Barbara Sawrey [1996] has used e-mail for years. She told her students that she would log on daily at least once between 10 P.M. and midnight to respond to questions. When she stayed at meetings on the East Coast, this entailed some late night hours for her. Her students usually sent mail to her between 5 P.M. and 4 A.M., a timing schedule she attributed to their e-mailing at the time of studying the material. Software programs she was instrumental in developing included "buttons" that permitted students to e-mail quickly and easily to instructors.

The most compelling point she made was in a comparison between e-mail traffic and live traffic at her office during office hours. Few students visited her office; many contacted her through e-mail. Most of us who teach at research universities find little traffic during office hours unless we introduce some strategy such as insisting that students pick up graded exams during office hours.

We use e-mail to maintain frequent contact with student teachers. A minimum of two weekly communications is expected, including the creation of a daily journal with entries for 2 or 3 days transmitted in each e-mail. In other courses, we insist upon e-mailed assignments.

Subsequent to the pioneering work of Sawrey and others, at least two caveats related to instructor use of e-mail have emerged. First, teachers who promise a prompt response are much more satisfied than are those promising a same day response. Those teachers promising a same day response to all queries received by 11:00 p.m. report becoming slaves to their system and students. Second, teachers of large classes report being flooded with questions. In response to this, Judith Poë [1999] suggests using a **frequently asked questions file [FAQ]**. A FAQ file presents a list of commonly asked questions together with answers. Not only has this reduced her e-mail traffic, but it has caused her to refocus many aspects of her instruction in an attempt to respond to the common questions in advance.

## Messaging

Messaging is a relatively new Internet phenomenon. Through messaging, it is possible for one person to communicate quickly with one or a small number of other persons. The software to accomplish messaging has become commonplace, and many large organizations with substantial Web presence offer messaging services. Microsoft, Yahoo!, and America Online offer messaging services, for example.

> What Is Instant Messaging?
>
> Instant messages are an online conversation between two or more people who have AOL Instant Messenger or America Online software. Instant messages are private and free. It's a whole new way of communicating that's fast, simple and totally addictive.
>
> {U05.11}

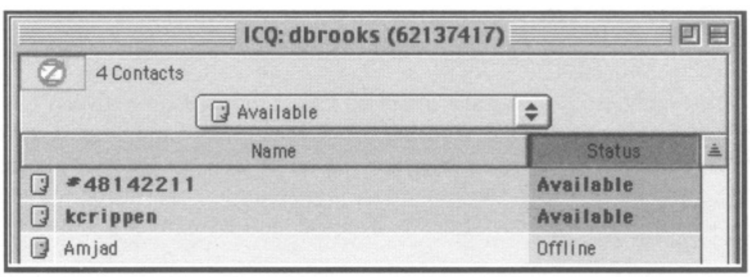



**Figure 5.04. Window of ICQ {U05.12} messaging software. This screen suggests that two persons are available to exchange messages with dbrooks, kcrippen, and 48142211. Double-clicking on a name or number brings up a screen for entering a message. Messaging is commonly included in courseware packages.**

Sometimes we use messaging software to communicate with one another in our offices. This prevents us from interrupting one another during times when we are deeply involved in computer work.

Instant messaging is moving from the hard-wired Web to the emerging wireless Web with small devices such as telephones, pagers, or Palm Pilots receiving those Web messages.

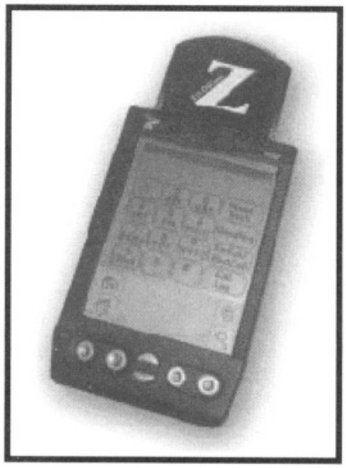


**Figure 5.05. The Visor {U05.13} from HandSpring is a personal digital assistant with the ability to add on complementary devices such as the communication package from Zilog {U05.14}. Together, these constitute a wireless telephone.**

## Listservs

Listservs are automated mailing lists. Mailing something to a listserv causes that message to be mailed to all e-mail addressees subscribing to that listserv. Readers of this book probably subscribe to several listservs. In fact, you've probably unsubscribed from one or more listservs to reduce the volume of material coming your way. An Internet course taught during the spring of 1995 concerned the use of small-scale laboratory activities in teaching high school chemistry. It used two channels of communication: e-mail directly to individual students, and a listserv. A listserv was easy to set up. The following student comment from the 1995 chemistry course listserv was in response to an experiment description and data posted by another student. The flavor of this comment is reflected in comments received when we present that material in workshops with face-to-face discussion and hands-on laboratory contact.

> MaryHelen's information on the Charles Law experiment looks very good. Could you please tell us whether this data was collected by you (MaryHelen) or your students? If it was your students, could you give us an idea of the time it took for them to get set-up properly? How about comments from them as to how easily they were able to get the pipette set-up with the colored water drop, etc.
>
> Student Comment, from Liu, 1996

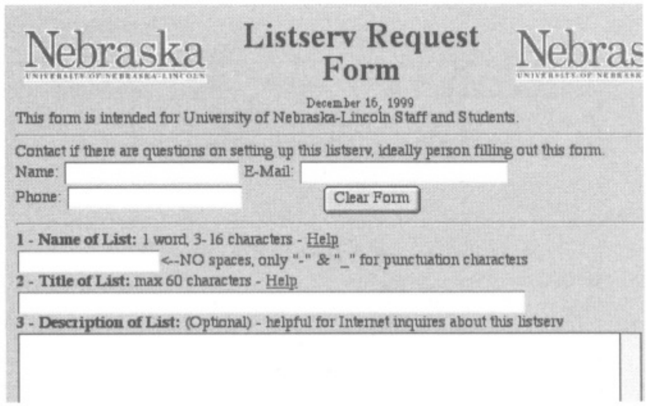



**Figure 5.06. Campuses typically set up listservs for faculty. The process on the UNL campus is Web-based and nearly automatic.**

Institutions usually run software for listservs on large computers, but listserv software for desktop computer servers is available.

Every teacher probably should set up some kind of listserv or discussion group for nearly every course taught. One way to handle group discussions is to create a "group" e-mail such that using this group name in an e-mail "To:" list causes each individual address in the group to be sent the message. Students may not know how to set up group addresses on their mailing software, however, forcing the teacher to relay messages from individual students to the class. A listserv is a better way to handle discussions, simple for both the students and the teacher.

Each author subscribes to several different listservs. Most of these are for professional development. A few provide us with personal information. Students at many levels should be encouraged to participate in listservs.

Some Web sites specialize in listing available listservs. During the interval between the publication of our first edition and the writing of the second, the nature of these sites has changed. We find many of our favorite listservs at the CataList {U05.15} reference site (Figure 5.07).

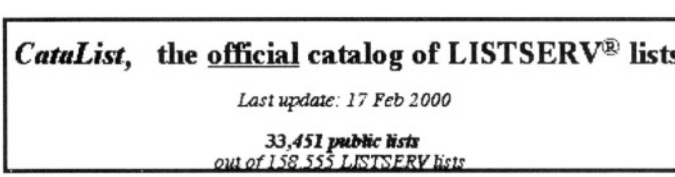



**Figure 5.07. Web site specializing in listing listservs.**

CHEMCOM

**Chemistry in the Community Discussion List**

Country: **USA**
Site: **State University of New York at Buffalo**
Computerized administrator:
**listserv@listserv.acsu.buffalo.edu**
Human administrator:
**chemcom-request@listserv.acsu.buffalo.edu**

You can join this group by sending the message "***sub CHEMCOM yourname***" to **listserv@listserv.acsu.buffalo.edu**

Figure 5.08. **Screen capture of information about the ChemCom listserv at the site noted in Figure 5.07.**

```
Date: Wed, 23 Oct 1996 09:00:35 MDT
Reply-To: chemed-l@mailer.uwf.edu
Sender: owner-chemed-l@mailer.uwf.edu
Precedence: bulk
From: xxxxxxxxxxxxxx
To: chemed-l@atlantis.cc.uwf.edu
Subject: Re: Scientific Writing Sample Needed

I use the 1935 issue of the Journal of the
American Chemical Society as a good source for
experimental analytical data on inorganic and
organic compounds for general chemistry
problems.  It is a nearly ideal source for the
scientific writing samples you want as well.

Sincerely,
Xxxx Xxxxxx
```

Figure 5.09. **Text of a message from the ChemEd-L listserv. This message is a response from a frequent contributor to an earlier question regarding scientific writing.**

## Web-Based E-Mail Groups

If your campus does not provide a listserv system, one is available from eGroups. A Web-based listserv system, it uses exposure to a small amount of advertising to support operations.

> What is eGroups?
>
> eGroups is a free email group service that allows you to easily create and join email groups. Email groups offer a convenient way to connect with others who share the same interests and ideas. Just a few ideas for using eGroups:
>
> - Get in touch with friends
> - Plan a family reunion
> - Send your business newsletter
> - Coordinate meetings, events and more!
>
> eGroups {U05.16}

## News Groups

If a listserv develops a great deal of traffic, you might want to consider changing to a user group or news group. A listserv offers automatic e-mailing so that all of the traffic comes to each member. Each must choose what to read and what to discard from his or her computer. In a news group, messages are posted on a server that is accessed by a news reading program. The user ultimately chooses which of the posted messages to open and read. News groups are inherently cleaner than listservs; the user takes what is desired, rather than discard what is not desired. Listservs are usually sufficient for most teaching situations.

| | | |
|---|---|---|
| JPI | Judge dismisses woman's Citadel suit | 2/16/00 9:30 AM |
| AP / AMP... | [Lg37] Mexico University Open After ... | 2/14/00 9:38 PM |
| AP / AMP... | [Sm37] Mexico University Open After ... | 2/14/00 9:38 PM |
| AFP / Law... | FBI focuses on university desktop com... | 2/11/00 9:00 PM |
| JPI | Curtis 'screams' for Hasty Pudding pot | 2/10/00 9:19 PM |
| AP / ANJE... | Sens.: Aid Can't Keep Up With Costs | 2/10/00 10:10 AM |
| AP / KATH... | Women Medical Faculty Face Barriers | 2/10/00 12:30 AM |

**Figure 5.10. Listing of articles available for reading from the clari.news.education.higher newsgroup.**

## Managing Mail

Nearly all contemporary e-mail software programs offer both mailboxes and filtering. "Mailboxes" hold messages according to themes set by the user.

Filters sort incoming e-mails into appropriate folders (mailboxes). Many e-mail programs offer the opportunity to set up "rules" that are applied when filtering or sorting the mail into folders. Any message that is not filtered into

some other folder ends up in the "Inbox" folder. We subscribe to many listservs. Mail from each listserv is sorted into a folder named for that listserv. Each of these folders is placed in one folder named "Listservs." In this way, the large amount of mail from a very high-traffic listserv such as ChemEd-L is sorted into a single place. A listserv can be temporarily "turned off" during out of town trips to avoid a backlog of unread messages. Using folders facilitates the quick review of important items upon returning from an absence.

Between e-mail and listservs, much more time is spent these days reading incoming information than a decade ago. Since responses can be immediate and composed casually, they take less time to create. In the absence of confirming data, we sense that the total time we spend communicating today is greater than it was a decade ago even though the individual communications may be more efficient.

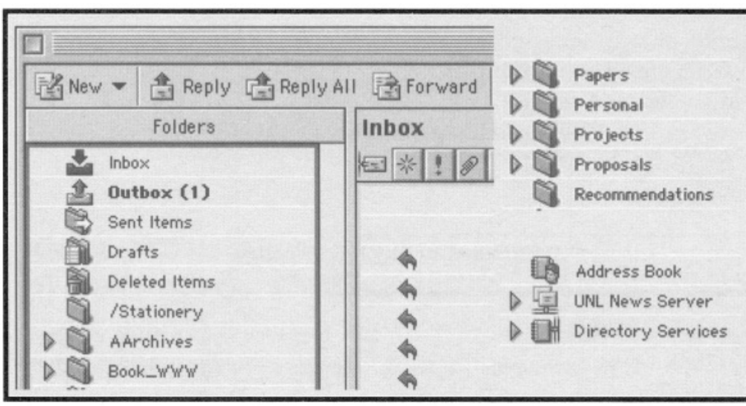



**Figure 5.11. Composite screen capture from *Outlook Express* e-mail program. Five mailboxes come with the program: Inbox, Outbox, Sent Items, Drafts, and Deleted Items. This user has added about 25 other mailboxes. These include Book_WWW (this book), Papers, Personal, Projects, Proposal, and Recommendations. Other features include Address Book (a collection of addresses, that include e-mail addresses), a connection to the University News Server, and a system for looking up e-mail addresses.**

While the total amount of time we spend engaged in electronic communications may not be spent efficiently, we are certain that our e-mails with our students are effective.

Much of the work we did in preparing this book depended upon sharing e-mails. We would attach current versions of the HTML documents and images, and pass these back and forth. We created a Web site first, and then created the print version (camera ready copy) from text derived from the Web site. While it

might be argued that other production schemes would have served equally well, it was clear that we could ask third parties to comment upon small portions of the early drafts very efficiently in this way.

Discussion Group Software

As experienced Web users might suspect, there are Web sites that specialize in disseminating information about discussion forums and related software. Numerous Web conferencing software packages are available.

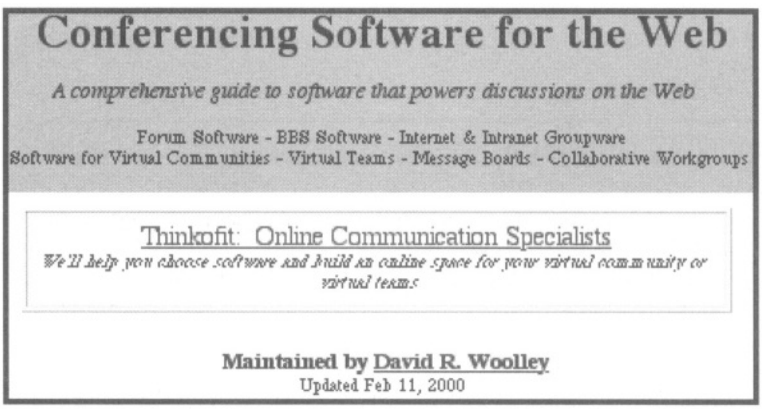



**Figure 5.12. Web Conferencing {U05.17} software site. Web conferencing usually means asynchronous conferences – where contributions are made successively at different moments in time. With permission.**

Web course management software packages nearly always include some sort of conferencing feature. Your teaching goal usually will be to make contributed information Web-accessible to your students in some fashion that is systematic enough to enhance their learning.

**Synchronous Discussion (Chatting)**

Discussions in real time have been available on the Internet for many years. Chatting is like messaging, except that messages posted to a "chat session" may be read by many people. Software {U05.18} supporting synchronous discussions is included in most course management packages (*CourseInfo* {U05.19}, *WebCT* {U05.20}).

Features of "chat" software often include:

- private "rooms"
- member lists
- private messages
- members-only access
- embedded HTML commands
- embedded URL links
- spellchecking
- freeware

Because typing still is a hassle for many people, voice-to-text software such as IBM *ViaVoice* {U05.21} may enhance contributions to chat rooms substantially.

**Videoconferencing**

Our first edition included the sentence, "Soon to come on the Web as an everyday technology are telephony and shared whiteboards." Though not quite everyday, these are becoming a reality. The biggest problem still is bandwidth. Even with the fastest processors and Internet connections at your school, the transmission speed for digital video and audio is still at the mercy of the daily traffic out on the Internet itself.

Inexpensive videocameras that will sit atop your computer's monitor and record continuously (Figure 5.13) are commonplace. Software such *as CU-SeeMe* {U05.22} can be used to post that video to the Internet. If you know the internet address of a video source, and you have appropriate software (*CU-SeeMe*), you can bring real-time video images up on your screen.

Both sender and receiver must be able to put lots of bits through their machines; video and sound take a great deal of memory. Also, the data streams move over the Internet, and each requires a big chunk of bandwidth, a demand that continues in real time for the duration of the connection.

Figure 5.13. Logitech QuickCam Pro {U05.23} 640 x 480 color camera.

Low-quality, Internet-based audiovisual communication, while far from perfect, is going to have a big impact on instruction. It is a very reasonable way to conduct many student/teacher conferences now held face-to-face. Faculty office hours can be arranged in advance by e-mail, and conducted from faculty home or office to student home or workplace.

In our opinion, completely unsupervised courses with little teacher/student interaction have little prospect for success. Staring at a screen and clicking on the "blue" lines is little different than flipping through the pages of a book with photons being reflected from the page and presumably arriving at the eye but with no important neural processing whatsoever. The learner gains little.

While Web teleconferencing may not be as good as presence in a classroom or office, it is likely to afford enough of a personal interaction such that the teacher can provide adequate motivation and direction for the students. It may equal or surpass what can happen in a lecture setting. We suspect it won't match what is possible when in a teaching laboratory. Web teleconferencing may do even more. With just a bit more sophisticated camera and some higher resolution software, the quality of the transmitted images might enable supervision of lab work or collegial assistance with interpretation of real phenomena. The hardware and software commonly in use today usually are not quite up to the task, however. Nevertheless, most such tasks are a lot less technically challenging than, say, transmitting quality X-rays for physician review.

Figure 5.14. Susan Gallagher's desktop camera acquires her image and transmits it over the Internet.

It has proven possible for small groups (three or four students) to work at a terminal while being encouraged and led by a faculty member at a distant site. The small-group work that we have required has often been a problem. Students may travel from far away, and find scheduling time with one another difficult. Electronic conferencing within student groups is a strategy for enabling student collaboration.

It is not yet clear the range of supervision that teachers can conduct successfully using Web video. For example, how much laboratory work can be safely and successfully supervised using the Web? We suspect that this area will receive substantial investigation due to potential savings in travel costs, however.

Several tutorial centers on our campus hold late evening hours. Scheduling these always is a challenge. There is a substantial perceived safety risk involved for late evening walks on campus. One can envision such tutoring being conducted between a teaching assistant's apartment or home and a student's dormitory or home via Web-conferencing.

## Telephony; Shared Whiteboards

Software is available to use the Internet as a telephone. The software and strategies available as of this writing are very dynamic. As noted earlier, the Internet is likely to replace the telephone, or at least change drastically typical telephone use.

Whiteboards that support concurrent users are available (Figure 5.15). Whiteboards are sometimes available within course management software. One user might mark with red, and the other green. *GroupBoard* {U05.24} offers whiteboarding software.

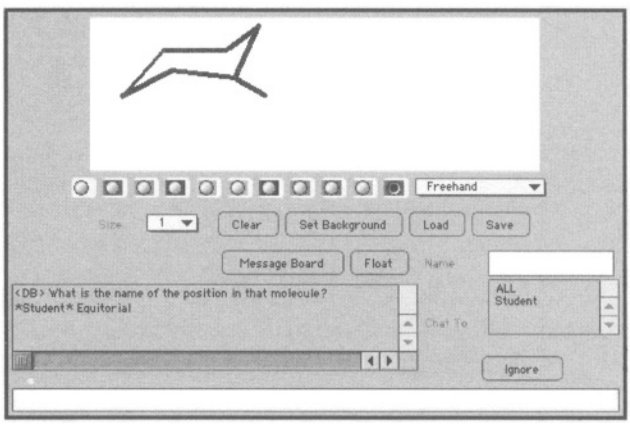



**Figure 5.15. Modified screen capture from *GroupBoard*. All users can draw. A chat feature allows communication related to the shared board.**

## GLOSSARY

asynchronous discussion: discussion occurring at different times (such as messages posted to a discussion board).

frequently asked questions (FAQ): some questions seem to arise over and over in asynchronous conversations, listservs, and newsgroups. To address this problem, create a file of frequently asked questions together with answers, and make that file readily accessible.

synchronous discussion: simultaneous discussion. Occurring at the same time (such as chat or videophone).

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U05.12. ICQ, http://web.icq.com/ (accessed 4/5/00).
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U05.14. Extreme Exprezzway Communicator™ System Development Kit (Zilog), http://www.zilog.com/pdfs/wireless/wavecommflyr.pdf (accessed 4/5/00).
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U05.18. Chat Software, http://wdvl.internet.com/Software/Applications/Chat/ (accessed 4/5/00).
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U05.20. WebCT, http://208.31.12.64/ (accessed 4/5/00).
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# CHAPTER 6

# Web Multimedia Basics

When first introduced, Andreessen's *Mosaic* {U06.01} browser brought forth an appreciation for the rich mixture of text and graphics that could be achieved using the Web. Designing Web materials is exciting. Ordinary people create some rather extraordinary media with the help of powerful computer application tools. Designing an online course involves focusing on many aspects of instruction. This chapter will introduce some elements of Web-design that are specific to teaching. A teacher needs to understand how things are accomplished on the Web to be able to design good materials.

## YOUR BROWSER AND COMPUTER FILES

The work of a browser includes transferring files. Browsers most often use the hypertext transfer protocol, signaled by the "http://" in the URL. A copy of the file is transferred from the server to the client. This copy is stored in a folder called the **cache.** While in your browser, try emptying the cache (in Netscape, Edit, Preferences, Advanced, Cache, click on Empty Disk Cache and then OK). With both the browser window and a window displaying the contents of the cache visible, access a few Web pages. Watch your cache fill!

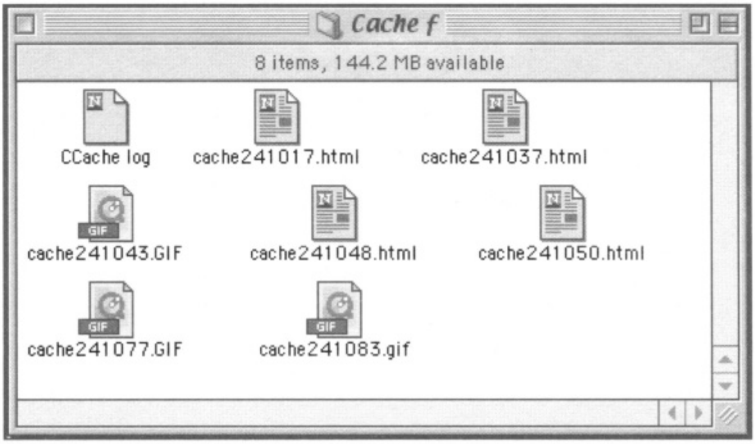


Figure 6.01. Appearance of the Netscape "Cache" folder. This folder contains the file "CCache log." When this folder is emptied except for the log, and the URL "http://dwb.unl.edu"{U06.02} is accessed, seven additional files appear in this cache. [For the technically inclined, there are four HTML files: one sets up two frames, one fills the upper frame, one fills the lower frame, and the fourth is generated as a base file – and is otherwise very similar to the file for the lower frame. There are three GIF images: a clickable map for the top frame, an animated molecule for the top frame, and the National Science Foundation logo for the bottom frame.]

## The MIME System

**MIME (Multipurpose Internet Mail Extensions)** is an extension to the traditional Internet mail protocol that permits communication of multimedia electronic mail [Graham, 1996, pp. 619-627]. You probably have noticed extensions on your own computer, especially when working in the Windows platform. Those extensions (generally two, three or four letters) at the end of file names tell your computer that a file is plain text (.txt), an Excel spreadsheet (.xls), or some other format. Those extensions eliminate the need to choose which application to use every time a file is opened.

Browser software uses extensions to determine how to use a file appropriately. When you contact a site by accessing the URL, the server sends back files. The MIME extension system provides your computer (the client) with information from the server about the type of file being sent.

Because MIME is a standardized scheme, it permits browser software to determine what to do with a file. The file is assigned an extension written as a period (or dot) and a few letters. Files ending in .html or .htm, for example, are interpreted as being HTML. Files ending in .gif are GIF image files, while those ending in .jpg or .jpeg are JPEG images.

In other cases, and especially with multimedia files, the browser may make use of **helper applications** and/or **plug-ins.** Different computer platforms (UNIX, Windows, Macintosh) handle MIME in slightly different ways, but with much the same effect. The extensions are defined in document RFC (Request for Comment) 1521 {U06.03}.

## Plug-ins/Helpers

Plug-ins and Helpers consist of computer code that complements a browser program and extends its capabilities. Plug-ins are intended to support specific types of data and allow clients on varying platforms to view the data. The plug-ins help eliminate much of the potential for cross-platform problems. Most client plug-ins are available without cost via the Internet. (In many cases, use of the software which creates the data requires purchase of a developer version of the plug-in or helper.)

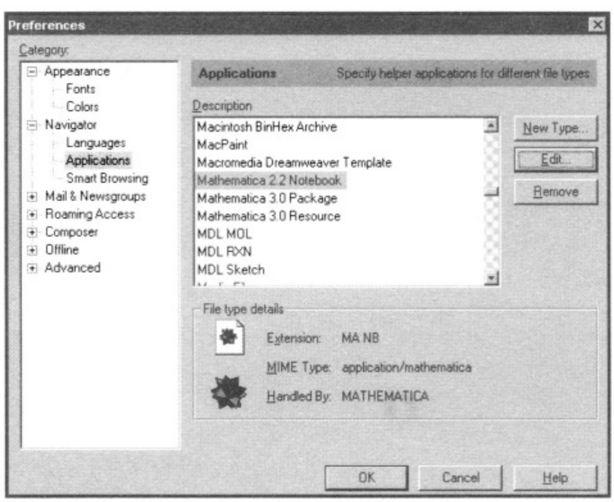


**Figure 6.02. Identifying helpers and plug-ins. This or a similar screen is available by choosing Edit, Preferences, Navigator, Applications in *Navigator* (or Edit, Preferences, Receiving Files, File Helper in *Internet Explorer.)* By selecting the Description, the File type details may be quickly viewed. Edit may be used to reassign the file type to a different application.**

By using this strategy, many specialized features can be incorporated with the browser. For example, chemists have considerable interest in displaying molecular structures. Typical users are not likely to share this interest. Because a plug-in architecture is used for the browser, computer programmers working for

chemists are able to piggy back their special needs on the overall power of the browser application. Several companies (e.g., Cambridge Soft {U06.04}, MDL {U06.05}) have developed plug-ins for browser-based manipulation of files for chemical structures.

Helper applications and plug-ins can be downloaded by students from the Web. When you request that your students use a specific plug-in, you may want to have this software available locally to facilitate their access. These local sources must meet copyright restrictions.

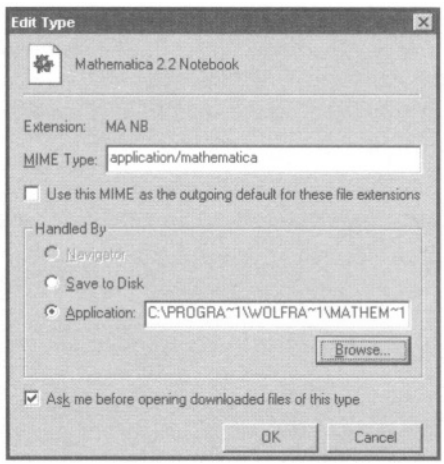


Figure 6.03. **Choosing Edit for one of the helpers (in this case, *Mathematica* 2.2 Notebook) allows suffixes to be entered/edited, and an application or plug-in chosen to assist the browser by handling the files involved.**

## TEXTUAL MEDIA

### Plain Text

After speech, text is the most important medium of the human condition. For scientists and engineers, it may be the most important. Scientists communicate in writing. Most professionals communicate in writing. As a teacher, you may be providing enormous amounts of text material for your students. Early in decisions about your course, you need to decide how you will handle text.

Paper is still a good medium for teachers; it is still the easiest text format to read in bed or on a park bench. Many things students are expected to learn require either a great deal of concentrated study, or a great deal of reading. Paper

is a good medium in both of these situations because of portability. Don't forget paper. Don't forget books. Experience shows that students *often* print Web materials for study.

## Conversion of Material

Material may be prepared for the Web in a variety of ways. Existing text which is in digital form usually can be converted into Web-useful formats by simple cut and paste procedures. If text material that is available only as print on paper is "clean," it can be converted to digital with a **scanner** and **optical character recognition (OCR)** software packages (i.e., *TextBridge* {U06.07}). However, when the text is handwritten or messy, or when small amounts of text are involved, retyping may be the best way to get this material into digital form. If you plan to use copyrighted materials, acquire permission from the source.

Substantial research has been expended on understanding the legibility of print material [Bloodsworth, 1993], and those who create either paper or electronic print documents are well-advised to become aware of the pertinent issues.

New text should be created using a word processing program, or some form of authoring software. Authoring software, especially when it presents the **pages** as they will appear in a browser, **(WYSIWYG,** what you see is what you get), provides a way to produce both text materials and other forms of media embedded in the text. With WYSIWYG, conversion of text materials to the Web or creation of text materials for the Web is rapidly becoming a relatively simple process.

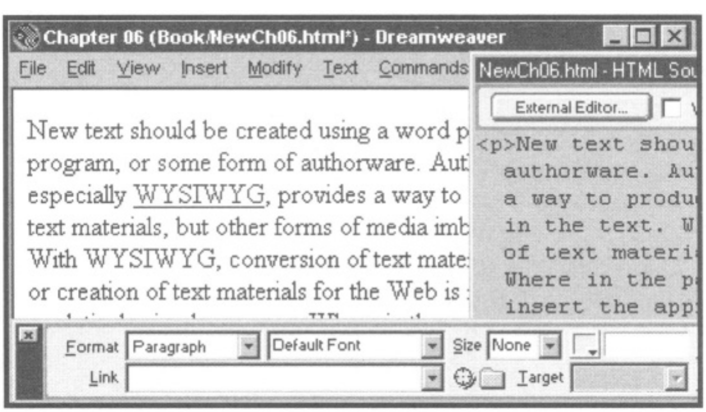


**Figure 6.04. Screen shot from *Dreamweaver* {U06.07}. The window at the left is the view of the Web page, the window at the right is the source of the page, and the window at the bottom is an example of a properties window.**

Where in the past an author had to learn a great deal about HTML in order to insert the appropriate HTML **tags** (a form of encoding that tells the browser application how to display the data), now most or all of these tags can be automatically inserted using a Web-friendly wordprocessing application, browser-embedded applications such as Netscape's *Composer,* or a high-power WYSIWYG application such as *Dreamweaver* (Figure 6.04) or Adobe *GoLive.* The user keys (or pastes) in the desired text and formats it by methods similar to standard wordprocessing and paint programs.

There has been an evolution in the creation of HTML files. When the first edition of this book appeared, the majority of HTML code was being written with text editors or HTML editors; the tags had to be keyed in by hand, a fairly clumsy way to work. Computer "experts" made up the majority of HTML coders.

**Shareware** programs were available, or simple text editors could be used. As software specifically for creating and editing HTML began to appear, more people were learning HTML and designing their own pages. With the advent of WYSIWYG authoring software, a broader range of users came along. With each new version of such software, the need to learn the HTML tags decreases, and the sophistication of what the software can accomplish increases. Even elementary school children can now design for the Web. Designing becomes more a matter of creation and less a job of implementation; the slow step becomes thinking about how you want the screen to look.

Ultimately, when you have numerous materials at a site, you may need to know enough about HTML to repair or adjust code. The newer authoring software versions are also becoming very adept at assisting in site management.

As one might suspect, the demands for delivery of more and more sophisticated pages have placed a strain on the original designs. HTML, actually derived from a more generalized markup language called SGML, is expected to give way to still another language – XML {U06.08}. The third edition of this book is likely to be produced in XML.

It is often important that files teachers provide for their students via the Web appear as they were intended. That's not always as easy as you might expect in Web publishing. (See figure 6.05.) Over the Web, things usually look similar from one screen to another – but they may not necessarily appear identical. Making the learner's screen look like the teacher's screen presents a problem. Anyone who has exchanged files extensively by e-mail has probably come up against files that were problematic. Macintosh files do not always convert easily to be viewed on a Windows machine, and some Windows files cannot be sent easily to some Macintoshes. Even transfers within one platform can be difficult. Also, files created in a newer version often will not open in an older version of an application.

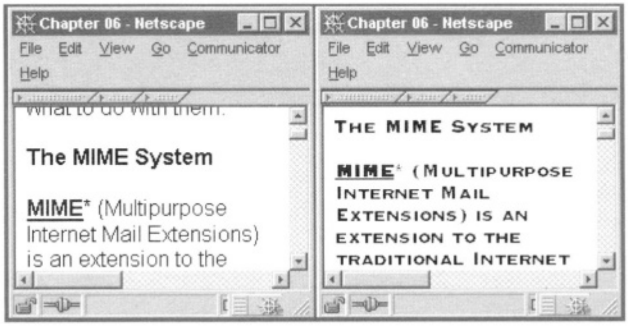


**Figure 6.05. Two views of an HTML-tagged file opened with the *Netscape Communicator* browser. The views differ in the font type setting chosen by the user. On the Web, you must work very hard to control exactly what the user sees. Most often, users don't see exactly the same screens as the author because of differing font and/or background color defaults.**

The appearance of text on the Web is controlled by "marking" the text with a series of tags as seen in Figure 6.06. In fact, the files are coded in a language called HTML (hypertext markup language). With modern word processors and authoring software, these HTML tags can be produced automatically. Using HTML encoded files can eliminate most of the cross-platform and within platform problems. But even then, if the files are e-mailed, the file may not be easy to transfer. HTML files may be saved as text files and transferred in text format, then saved on the recipient's machine and opened in some form of authoring software and resaved as HTML files. (Or the file extension may be changed to HTML and the file opened directly in the browser.)

```
<HTML><HEAD>
<TITLE>Chapter 06</TITLE>
<LINK rel="stylesheet" href="../WT.css">
</HEAD>
<BODY BGCOLOR="#FFFFCC">
<p>The appearance of text on the Web is controlled by &quot;marking&quot; the
text with a series of <a href="#tag"><b>tags</b></a><b>* </b>as seen in Figure
6.5. In fact, the files are coded in a language called HTML (<a
href="#hypertext">hypertext</a> markup language). With modern word processors
and authoring software these HTML tags can be produced automatically. Figure
6.4 shows the resulting screen. Using HTML encoded files can eliminate most of
the cross-platform and within platform problems. But even then, if the files
are e-mailed, the file may not be easy to transfer. HTML files may be saved as
text files and transferred in text format, then saved on the recipient's
machine and opened in some form of authoring software and resaved as HTML
files. (Or the file extension may be changed to HTML and the file opened
directly in the browser.) </p>
</BODY>
</HTML>
```

**Figure 6.06. A sample of an HTML-tagged file which would create a Web-based version of the prior paragraph. A further discussion of the basic elements of HTML tags appears in Chapter 8.**

When text is available on the Web, the problem of creating print copies (paper copies) is transferred from the teacher to the end user. If the student wants a print copy, the browser software can create it. The act of accessing the URL downloads the information from the teacher's machine (the server) to the student's machine (the client.)

Be very cautious about your use of copyrighted materials. Check with your campus bookstore or a local printer (like **Kinko's).** They may be able to secure copyright access for Web applications if access to your server is controlled.

## HYPERTEXT

The hallmark of hypertext is dynamic access to information. To emphasize its potential, we classify hypertext as a type of medium. In multimedia instruction, appropriate use of hypertext is a mark of literacy. Textbooks have been highlighting new vocabulary with bold or colored text for many years. With computers, we can extend this highlighting by making the words and phrases hypertext. Clicking on hypertext can lead directly to different text (or other media) located elsewhere in the same document, or in an entirely different document, perhaps one located on a different server – with servers located around the world.

Teachers can have an interactive glossary set up so that, when new words are introduced, the user can click to obtain a definition. Traditional, unlinked text, and especially textbooks, may remain the most important medium you'll use as a teacher. But hypertext will become an essential in your toolbox! The newer, Web-oriented software makes creation of hypertext a relatively simple matter.

This book has a glossary, references, and URL lists at the end of each chapter. The Web-site associated with this book {U06.09} provides an example of an interactive glossary and hyperlinks to URLs for a wide variety of resources.

## SOUPED-UP HYPERTEXT

Beyond simple hypertext, the addition of animations, movies, sounds, **JavaScript,** and other **hypermedia** can bring a site alive and help make it involving and interactive. JavaScripting within Web pages is now common to the Web. **Java** applications (**applets**) have an exciting look and feel to them. Chapters 7, 8, 14, 15, and 16 will examine multiple forms of hypermedia which can be used to expand your site.

### When and Why to Use Each

Plain, unlinked text is likely to be the very beginning of the design of your site. Articles intended for conventional reading may need little else. Before you make your text available to your students, consider adding hypertext links where they seem appropriate. Links to glossary words should appear the first time a word appears, but not every time it is used. Links to other sites may be included in the body of the text, or isolated in references at the end of the text.

The challenge is to provide adequate links without allowing those links to distract from the information to be read. Pictures and graphics, added to the text, can provide visual clues to learning. More elaborate hypermedia should be reserved for encouraging interactivity and providing dynamic examples for learning. Remember, early research results do not support the notion that special gains are attributable to hypermedia [Dillon & Gabbard, 1998].

> Clearly, the benefits gained from the use of hypermedia technology in learning scenarios appear to be very limited and not in keeping with the generally euphoric reaction to this technology in the professional arena.
>
> Dillon & Gabbard, 1998

The use of hypertext is an open issue. Spiro et al. {U06.10} point out that knowledge in the Web world is ill-structured, and that developing materials that help learners deal with this knowledge effectively remains a challenge.

### Why Reinvent the Wheel?

Rather than write materials each time you need them for your students, search the Web to see if appropriate material already is available. If the material is not quite what is needed, it may help in the design of new material. Web authors usually don't hide their HTML code; it can be accessed from any browser. The page can be saved and accessed using authoring software. It is often possible to figure out how the author accomplished any special effects. By saving the page to a local machine, editing and modification become possible. Be sure to save all the parts, including any images.

Copyright exists on the Web (see Chapter 19). Request permission before using any substantial amount of code or any images. If material will be used by including a link to the original site, before publishing the link, contact the site administrator. Contacting the administrator can help ensure the site is stable for your use and able to handle the additional traffic that your link might create for that site.

### Beware the Bells and Whistles

As the capabilities of the Web become more apparent, and the authoring of very complex pages becomes simpler, there is a temptation to fill pages with illustrations, photos, decorations, and the myriad of hypermedia. The usability of the page needs to be kept in mind. As you add graphics, keep in mind the increasing length of time to download the page. If you need to include 100 pictures, consider using hyperlinked descriptions or thumbnail versions of the pictures to minimize download time.

## HTML BASICS

When you use your browser, the page you see is rendered so that the various “tags” have been implemented. It is possible to look at the HTML file from which that page is rendered and view the tags. By choosing “Page Source” in the “View” menu of the browser, the HTML source can be displayed on the local screen.

It is possible to learn a great deal about HTML and JavaScripting by viewing and manipulating the code written by others, especially when done together with a basic HTML reference book such as *HTML 4 for Dummies* {U06.11}. To manipulate the code, it may be necessary to save the file to the local machine and open it with some form of authoring software. (The Mac versions of some browser software allow manipulation within the browser.) The source code is visible for public perusal; HTML does not provide a way to hide the code. Using large sections of code written by others may become a copyright issue.

HTML tags include formatting information for the browser about how to display the file. The tags are commands which are enclosed in the < and > symbols. The first tag in any document is <HTML>, telling the browser to begin formatting with HTML. Next there is usually a section which serves as a header to the file, called <HEAD>. Several header information tags may appear within the <HEAD> area of the document. To close the <HEAD> area, the </HEAD> tag appears. (The slash in the closing tag is used to indicate the end of material affected by the original tag.)

The header is usually followed by the <BODY> tag, indicating the beginning of the visually displayed document. Within the body of the document, a variety of tags will appear determining such things as color, spacing, font choice, font styles, and hyperlinks. At the end of the document, a closing tag will appear for both the body </BODY> and the HTML code itself </HTML>. A few HTML tags do not require a closing tag. For example, the <BR> tag causes a carriage return (line break) without creating a change in paragraph.

## The Hyperlink Tags

A key idea in the HTML scheme of things is the hyperlink. Hyperlinks are accomplished through the use of anchor tags. The properties of the hyperlink are explicitly encoded in a cumbersome text string. Good authoring software allows the developer to specify several elements of the link in a "properties" dialog box, and automatically inserts the proper tags. The complete links, including the URL, file or text string (anchor) to access, and even information about how to display the information are visible in the HTML source. In the browser screen seen by the user, links are usually only evidenced by clear, but subtle, changes in the text format – colored, underlined text, or **hot spots** on the screen.

The links in a Web browser can bring about quite minor changes – with a link in one part of a document connecting to another part of the same document. The user clicks on a linked text string, and the screen images change, displaying a different portion of the same document. Alternatively, the links can point to documents that can be downloaded from servers literally continents away. They may be opened in the same window, or in a new one. With modern browser software, the suffixes attached to files can be used to invoke helpers and plug-ins that enable a full range of multimedia applications.

## The Anchor Tag

Perhaps the most important of the "tags" in HTML is the anchor tag, <A> …</A>. Two critical attributes of links may appear within an anchor tag: names, and hrefs (the URL or file path to access the required information.)

## The Name Attribute

The name attribute within an anchor tag is used to give a name to a piece of text for access via hyperlinks. (*Netscape Composer* uses the term "target" in place of anchor.) The name tag shown below would assign the name Baubles to the phrase "Baubles Section" at a particular location in the file so it could serve as a destination for a hypertext link. This name (sometimes called an anchor) will be located at the destination of a link.

<A NAME="Baubles">Baubles Section</A>

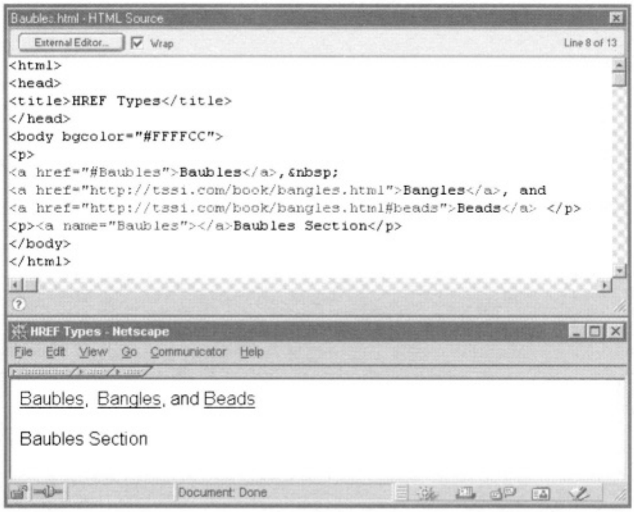


**Figure 6.07. Top: HTML file with three links. Bottom: appearance of this file as displayed in browser. The first link goes to a named place (the "Baubles Section") within the current file. The second goes to a different file, on the same or a different server. The third goes to a named portion of a different file on the same server where the second file is located.**

### The HREF Attribute

The HREF attribute within the anchor tag is used to indicate the URL for a hypertext link. The HREF can send the user to another point in the current document, to another document of the same server, to a document on a different server, or even to a specific point in a document on a different server. Figure 6.07 provides a few HREF attribute examples.

## ALTERNATIVES TO HYPERTEXT

### The Powerpoint Lecture

Many teachers, especially college teachers in large, lecture-oriented classes, have begun creating materials in the format of electronic slide programs. These generally are called presentation programs. Microsoft's *PowerPoint,* a part of the Microsoft *Office* suite of programs, is widely used. In the same way that photocopies are often called xerox copies, lectures utilizing presentation software are often called powerpoint lectures. Powerpoint slides have a characteristic look and feel, illustrated in Figure 6.08.

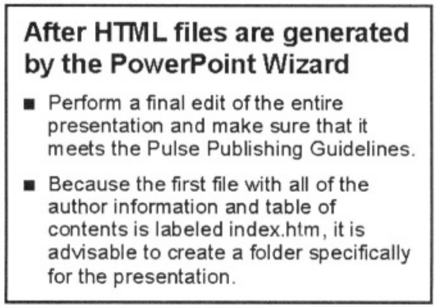


Figure 6.08. **Characteristic look and feel of a powerpoint slide. Modified screen capture from *PowerPoint* presentation by K. Chinn, "Optimizing PowerPoint Presentations for the World Wide Web." {U06.12}**

Media services at Eastern Illinois University has Web information related to creating online powerpoint {U06.13} presentations. Kuchler {U06.14} suggests three ways to make powerpoint presentations available to students: using the original format, converting to HTML format, or converting to Real streaming video format. This rather scholarly Web paper makes several appropriate comparisons of these three formats. Zoll [1998] {U06.15} argues that powerpoint formats really are not appropriate for the Web, and we tend to share that view. If you do make a classroom presentation to a group as part of your teaching, then *PowerPoint* makes for an excellent tool. If an existing powerpoint presentation is your starting point, then putting that material on the Web is likely to be the least time-consuming way to go.

### The Acrobat .pdf File

Students often print out files to view at a later time. There is evidence they read materials from those printed files, even ones printed from "souped-up" hypertext (where printing results in losing important information.) Hypertext files printed from browsers often do not reflect the format intended.

If formatting of the page is critical for your teaching application, Adobe *Acrobat* software {U06.16} can provide a workable solution using **.pdf** files. Although the software for encoding the files must be purchased, that needed to read the files, *Acrobat Reader*, is available without charge across the Web.

> The essential tool for universal document exchange
> Tired of colleagues not being able to open your documents? Frustrated by software and platform incompatibilities that destroy your documents' look and feel? You need Adobe® Acrobat® 4.0 software. It's the most reliable, efficient, and effective way to share information electronically. Acrobat lets you convert any document - including entire Web sites -into an Adobe Portable Document Format (PDF) file, with its original appearance preserved, and then viewing and printing on any system. Powerful markup tools make electronic review a snap, so you can collaborate more easily and productively than ever before.
>
> Adobe *Acrobat* {U06.10}

*Acrobat* is an evolving software product, one whose feature set has grown far beyond that originally provided.

### Choosing Formats

We prefer to have students using the Web to access hypertext files rather than either files developed to support a linear lecture strategy (*PowerPoint*) or those optimized for printing (*Acrobat*). If the student downloads files, why not download a folder that includes all of those files necessary to reproduce a lesson originally intended for Web delivery. Many organizations use *Acrobat* (i.e., .pdf-format) files, especially when review of texts is the key feature. The *FastLane* {U06.17} reporting system of the National Science Foundation, for example, uses .pdf files throughout. This makes sense in the context of how the NSF conducts its reviews and manages its business. Recent browser software has integrated *Acrobat Reader* as a helper application, making reading .pdf files on the Web simple.

For teaching, however, especially when one set of documents is intended to accommodate branched as well as linear learning styles, hypertext seems to be the best currently available route.

## TRANSFERRING FILES

### Downloading (Server to Client)

Browsers work by transferring files. Sometimes, especially in teaching situations, you may want to transfer a file to students for their use in some fashion less ephemeral than temporary storage in a browser's cache file. Web delivery {U06.16} is remarkably easy to accomplish, and makes use of the MIME extension system.

**Compressed** files, especially in the Macintosh platform, may use the .hqx file extension. This indicates they have been encoded for transfer across the Internet (in a format called BinHex.) In the Windows world, the .zip extension

accomplishes a similar end. Once transferred to the client, the encoded file must be decoded before use. This usually is accomplished automatically with designated helper applications. Both application and document files may be transmitted via the Web using this “compress, package, transfer, unpackage, and decompress” strategy.

Web file transfers are alternatives to ftp file transfers. Occasionally, an organization will choose to use the ftp (file transfer protocol) strategy instead of the **http (hypertext transfer protocol)** strategy. When accomplished through a browser, this nuance of process usually is not noticed by the user.

In spite of the enormous efforts, cross-platform problems tend to plague file transfers. Usually separate files must be available for Mac versus Windows. If students are using other platforms, those platforms may require yet other sets of files. Files which are strictly HTML are an easy transfer, but other files need special treatment. As a teacher, you may spend quite a bit of time accomplishing something as simple as providing all of your students with the same template file for a spreadsheet. Once you have local procedures down, however, this too becomes remarkably simpler than conventional techniques like having all students show up with floppies at a designated computer lab to make copies of a file.

## Uploading (Client to Server)

If you are courageous, you can have students upload files to you. In the event you do have students upload files to your server, always use virus protection! Especially in colleges and high schools with student computer laboratories, pesky viruses may be transmitted innocently by students (see Chapter 18).

One way to receive files is to have students attach them to e-mails. Another strategy is to use server software that facilitates these transfers. *WebSTAR* software is one way to handle this.

> Using the WebSTAR File Upload Plug-In
>
> WebSTAR does not install the WebSTAR File Uploader Plug-In by default. Use the WebSTAR Server Suite Installer to install it. It does not require any additional RAM. The File Upload Plug-In will always allow uploading if there is a file named upload in a folder, and an appropriate HTML form. To use the WebSTAR File Upload Plug-In, you must create a *.upload* file in each folder that will be display a listing. It’s just a text file, named with a period followed by the word “upload.”
>
> WebSTAR File Upload Plug-In {U06.17}

### Push versus Pull

Most Web transactions involve the client sending a message to a server, and the server responding by sending back one or several files. This is called pull technology. In push technology, a profile is established indicating the kind of information the user wants to see: This information is then pushed to the client. Push technologies include pointcasting, multicasting, and Webcasting. Advertisers, of course, are interested in push technologies. Push technologies often are used on intranets.

Push technologies can be useful for teachers, especially when Web technologies are used to handle synchronous, multimedia intensive instruction. In teaching courses in plant pathology, James Partridge of UNL uses a multiframe format. One frame displays streaming video from a live classroom presentation. Another is used to share visuals such as in a powerpoint presentation.

## GLOSSARY

applet: an application written in the Java language intended for inclusion within a Web page.

cache: a temporary storage place. This can be a folder where files are stored, a chip where memory is stored, or a disk where something is written to the disk temporarily.

compression; compressed file: file in which wasted space has been removed by using a computer application that replaces current bits and bytes with new ones. Formulas or algorithms allow duplicate or empty space removal, and also permit reconstruction of the original file identically (**lossless** compression) or nearly identically (**lossy** compression).

helper application: program used by a browser to assist with some task or operation. For example, *Navigator* uses the helper application *StuffIt Expander* to translate and expand .hqx (dot hqx) files.

hot spot: an area of the screen which, when clicked, is expected to bring about some action such as moving to a different section of text, playing a movie, showing in image, etc. When the pointer (cursor) moves onto a hotspot, the shape of the cursor changes to that of a hand with a pointing finger.

http (hypertext transfer protocol): a procedure used by computers to transfer files from servers to clients (browsers). This is the principal procedure used on the Web.

hypermedia: multimedia linked so as to permit branching from one place to another based on the intent of the user (or programmer).

Java: a programming language developed by Sun Microsystems made especially for Internet applications.

JavaScript: originally called LiveScript, a language developed by Netscape to enhance the interactivity of client-side materials by incorporating the programming with the materials downloaded to the client.

Kinko's: commercial supplier of information handling services centering on multimedia production and especially duplication services.

lossless; lossy: descriptions of file compression strategies. Lossless compression retains all of the information so that the compressed file may be reconstructed exactly. Lossy compression involves some loss of information. JPEG and MPEG are lossy compression formats.

MIME (Multipurpose Internet Mail Extension): standardized scheme that permits browser software to determine what to do with a file. The file is assigned an extension written as a few letters and a period or dot. Files ending in .html or .htm, for example, are interpreted as being HTML tagged text. Files ending in .gif are GIF image files, while those ending in .jpg or .jpeg are JPEG images. A file ending in .hqx has been encoded (in a format called BinHex 4.0) so that it can be transferred from computer to computer.

Optical Character Recognition (OCR): a scheme for taking printed images as from typewriting, newspapers, and books, and converting those images of letters into digital text files usable by computers.

page: describes a hypertext file transmitted from server to client using the Web.

.pdf; (Portable Document Format): a file format developed by Adobe that has captured all the elements of a printed document as an electronic image.

plug-in: dynamic code modules, native to a specific platform on which a browser runs, that enhance the capabilities of the browser.

scan; scanner: to scan an image is to create a digital file from the image. A scanner goes from analog information (the picture itself) to a digital file from which the image can be recreated on a computer display device.

shareware: software created as a public service and provided for testing after which, if used for substantial time (usually defined as a month), the user is honor bound to pay a small fee to the creator.

tag: in HTML, code embedded within an ordinary text file that may be interpreted by browser software as an instruction. Tags are markup instructions for text that are embedded in text. In HTML, tags are set off by the "<" and ">" symbols. Tags are programming instructions.

WYSIWYG: (pronounced WIZ-ee-wig) software which provides a "what you see is what you get" medium for producing HTML text. Whatever appears on the design screen will appear the same when viewed.

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# CHAPTER 7

# Interactive Strategies

The creation of interactive environments between students and teachers is critical to teaching on the Web. *Web-Teaching* addresses this question in five chapters. Chapter 5 dealt with discussion. This chapter focuses on those interactions most easily managed using browser, server, and e-mail software. Chapter 14 addresses the use of databases and database software, adding another level of interactivity – at the expense of increased complexity. Chapter 15 discusses the issue of online testing. Chapter 16 addresses the most advanced forms of interactivity, such as simulations designed specifically to illustrate concepts.

## CLASSROOM TRADITIONS

By using questioning and other techniques in your classroom, you can elicit responses and give feedback on a time scale measured in seconds or minutes. Each student can be called on, and you can question in such a way that nearly all students are prepared to respond. If you use cooperative strategies, you might even be successful at utilizing more questioning to get higher overall response rates. Active learning might seem to be easy to achieve in a classroom. As the teacher, you can ask questions. Sometimes your glances or gestures can evoke significant student participation. Research supports the notion that teacher questions can be effective; however, the effects are smaller than teachers think (Cotton, {U07.01}). The tasks that the teacher sets for the students usually determine the extent of active learning.

This chapter has a twofold purpose. One dimension focuses on the nature of the task of creating active learning environments, and the other on the tools available to help accomplish that task. This chapter ends with a review of a very

available to help accomplish that task. This chapter ends with a review of a very promising system where teachers use the Web to obtain up-to-the-hour information related to student performance.

### Active Learning

Lecturing has long been the primary means of instruction in education. Gregg Schraw, a researcher in self-regulation, argues that lectures work well for poor self-regulators. During class, the lecturer can drop survival hints, strategies, and other clues that help poor self-regulators survive. Good self-regulators perform well in just about any learning environment.

Many books provide seemingly clear exposition of content. In spite of round-the-clock access to those books, student performance may fall below expectations. Books, even coupled with lectures, often give less than desired learning outcomes. Just having clear learning materials available, even with the support of a skilled and enthusiastic teacher, may not be enough to bring about learning.

As mentioned in Chapter 2, research suggests that the most efficient learning environments require active learning. As a teacher, you need to create and employ strategies to make learning active. How do you create an interactive environment for your students when they are sitting in front of monitors somewhere on the Web?

Hypertext links, clickable maps, and forms will help you make your Web pages more interactive.

## HYPERTEXT LINKS

Hypertext is nonlinear, or nonsequential text. The text is organized so one can easily jump from topic to topic. You do not need to read the text in a fixed or linear sequence. Although hypertext probably is best brought to life on a computer, hypertext style documents exist outside of the Web (i.e., self-paced texts, Choose-Your-Own-Adventure books {U07.02}). Hypertext is readily achieved within Web documents.

Hypertext requires readers to make decisions about their reading. It is an active learning strategy. Multimedia programs such as *HyperCard* or *ToolBook* have enabled hypertext for over a decade. In fact, they were among the earliest drivers for videodiscs – providing remarkable user control in multimedia learning environments. Hypertext links facilitate choice and, therefore, are potentially valuable instructional tools.

This book was written as a Web document, and then converted to paper. In the Web version, moving the pointer (cursor) to an underlined word and clicking the mouse brings up a definition of the word. If you are using this book on the

Web, click away. However, if you are reading the book in paper, and you want the definition of a word right now, you'll need to turn to the glossary.

There is a design issue with hypertext. As the designer, you must decide where a link would be appropriate, and you must put it there. Some think the computer ought to be able to do that for us automatically. That requires a level of artificial intelligence not yet available.

Since hypertext links most often appear underlined in a characteristic color, underlining for emphasis is all but excluded in well-designed Web documents. Underlining is reserved for the indication of a hyperlink. Another clue to the existence of a hyperlink is that, in Web materials, the shape of the pointer (cursor) changes to a hand when it passes over a hyperlink. An underlined name means that clicking it will access a personal Web page, or open an e-mail composition window addressed to the person.

If there is a hypertext link in your materials, it is because you put it there. You decide which links may be appropriate. You decide whether to create materials yourself or send students out on the Web to find information. You decide how to get students back to the learning materials without getting lost in hyperspace. You decide if the link opens a new window or replaces the information in the current window. You may need some way to bring students back to the track you have created. These are all instructional design issues.

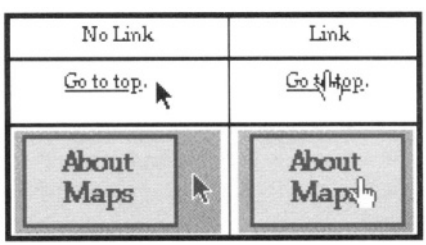



**Figure 7.01. The arrow cursor on the left suggests no link; the hand cursor on the right suggests a link, and that clicking will bring about some action – going someplace implied by the image or text.**

What kinds of materials are well suited for the Web? Since publication of the first edition of *Web-Teaching,* it has become clear that practically any subject can be treated using the Web. As we noted earlier, even some heavily value-laden topics seem to be handled well in this medium.

Should you try to devise a way to determine how many links your students visit? Unfortunately, keeping track of students' moves on the Web is very difficult.

Schwartz [1995] brings up important issues regarding the voice of the author. In a traditional, linear text, the author's voice is preserved. With

hypertext, you may need some way to bring the students back to the track you've created. Also, research indicates that weak students fair poorly with hypertext [Dillon & Gabbard, 1998].

## CLICKABLE IMAGES

The Web is replete with images that, when clicked, cause something to happen. Some images change just by moving the cursor on top of them. In HTML jargon, an image that has clickable hot spots is called a map. An **image map** is a sort of program. A map makes it possible to have just a part of an image interactive, or to have different parts of images interact in different ways. When browsers first came out, creating maps was a big deal. Today the best programs for creating Web materials (e.g., *Dreamweaver*, *GoLive*) make the creation of maps straightforward.

As noted in Chapter 4, when you're on the Web and see some large graphic that seems to say "click me," you probably are interacting with an image map. As shown above, when the cursor changes from a pointing arrow to a hand, a link is implied. The user is presumed to have garnered enough Web experience to know to click and, with the passage of time, that expectation becomes a reality (see Chapter 4). If you have been on the Web often, you have interacted with a map more than once during your excursions.

## FORMS

Hypertext links afford a large degree of interactivity. However, having students surfing without a purpose is not effective. In principle, it is possible to create interactive materials that involve only clicking. We developed a demonstration example {U07.03} that does just that – testing using only hyperlinks. Most teachers want some feedback from students that shows more learning than just making choices about branching. This brings us to the **FORM** tag of HTML. Forms are not a simple matter. You must decide how you will gather and use the information obtained from a form. The simplest procedure is to have that information gathered using a form e-mailed either to you or to some grader or recorder.

Chapter 15 discusses ways to have form information processed automatically at the server. That requires programming. It can be simple, copycat programming, but it is programming nevertheless.

The variety of form input **elements** is increasing. As new types are added, the power of this method increases. Gaps remain. It is not yet a simple matter to input voice, or to capture a simple sketch created by the learner.

HTML coding which includes any of the form elements must always be surrounded by the <FORM> and </FORM> tags. These tags tell the browser that the information between them describes a form.

## Building Forms

With current Web page creation software (e.g., *Dreamweaver*, *GoLive*), creating forms is simplified. You don't have to know much about the ins-and-outs of HTML coding. Creating a form is a matter of choosing to insert the form element or drag an icon of the desired form element onto your document, the coding is done automatically.

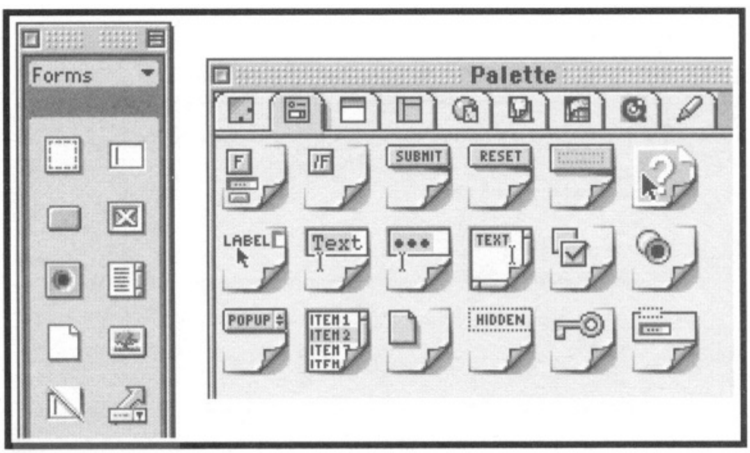



Figure 7.02. Form creation tools for *Dreamweaver* (left) and *GoLive* (right).

## Brief Responses

The TEXT element affords an open-ended, free-form response from a learner. It is equivalent to what teachers might call a short-answer response in a quiz. TEXT can be used to obtain the student's name, address, and other personal or demographic information.

```
<FORM>
<B>Enter Address:</B>
<INPUT TYPE="text" NAME="Address"
VALUE="Your Home Address"  SIZE=30 MAXLENGTH=28>
</FORM>
```

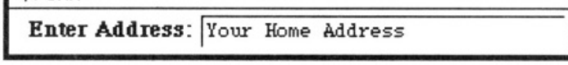



Figure 7.03. Top, HTML for creating a TEXT element in a form. Bottom, screen capture of that TEXT element in the form.

The TEXT input element has much potential for teachers. For example, if a student should be able to perform a calculation, then this might be the way to get feedback about the result.

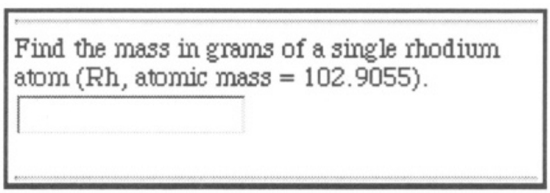



Figure 7.04. Screen capture of a TEXT element in a quiz form.

Questions can include media. An accompanying figure can either be the subject of the question or be a useful clue. Figure 7.05 shows a question involving an image.

```
<FORM>
<IMG SRC="DDT.GIF" ALIGN="LEFT">
Identify this molecular structure.
<BR CLEAR=LEFT><BR>
<INPUT TYPE="text" NAME="Molecule"
SIZE="30"> <BR>
</FORM>
```

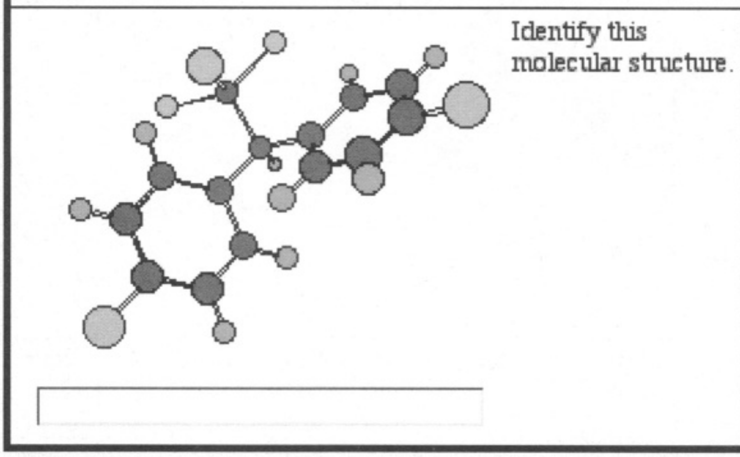



**Figure 7.05. Top, HTML for creating a TEXT element in a form with accompanying image. Bottom, screen capture of that TEXT element in form.**

## Extended Responses

The TEXTAREA input element permits learners to write a great deal of text for inclusion in their response. This is where a student might be asked to write one or several paragraphs (Figure 7.06).

As of this writing, it is exceptionally unlikely that you will have or be able to create software tools that will adequately judge the quality of a lengthy student response. For that reason, you'll probably be reading all of this material yourself, or directing it to some grader or reader.

```
<HTML>
<HEAD>
<TITLE>Peroxide Question</TITLE>
</HEAD>
<BODY>
Question 9.  Suggest ways to increase the shelf
life of dilute <BR>hydrogen peroxide solutions.
Indicate reasons for your choices.<BR>
<FORM ACTION="mailto:dbrooks1@unl.edu"
METHOD=POST>
<TEXTAREA NAME="Question 9" ROWS=5 COLS=40
WRAP="virtual">
</TEXTAREA><BR>
<INPUT TYPE="submit" VALUE="Send Answer to
Instructor">
</FORM><HR>
</BODY>
</HTML>
```

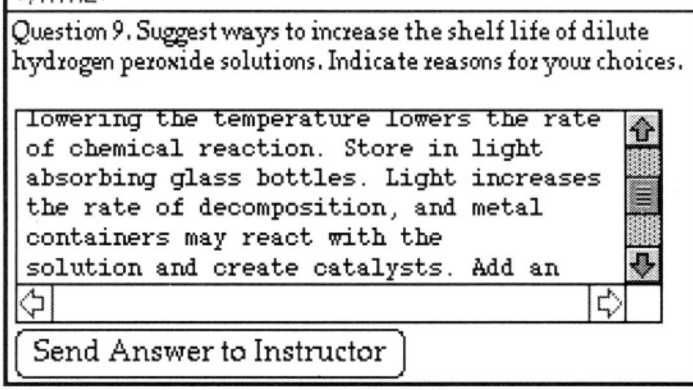



**Figure 7.06. Top, HTML for introducing TEXTAREA element in a form. Bottom, screen capture of that element after it has been filled in. Students can send large amounts of material to you for evaluation. This information can be directed toward your e-mail. By adding the attribute WRAP="virtual" to the TEXTAREA element, the information typed by the student will wrap automatically on their screen in newer browsers.**

## Disguised Responses

The PASSWORD element is similar to text except that the typed characters are encoded into large dots so that persons watching the screen cannot tell which characters have been typed (Figure 7.07). As its name implies, the most common use of this input element is for entering passwords. One possible application would be to have two or more students working on the same

computer. The responses could be kept secure from one another by being entered as passwords, automatically hidden by the dots.

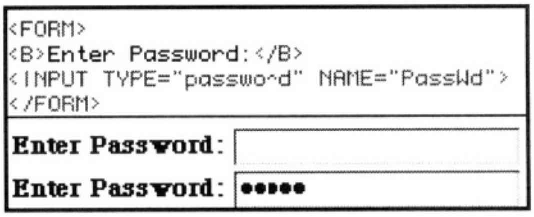



**Figure 7.07. Top, HTML for creating a PASSWORD element in a form. Bottom, screen capture of that PASSWORD element in form, first blank, and then filled in.**

## Covert Information

The HIDDEN input element affords some real power to the teacher. In the online chemistry test we developed to demonstrate Web interactivity, the starting point asks users to enter their name. Once this is entered by the user and submitted in one item of a form, all of the subsequent documents (which consist of exams and exams with answers) identify the user by name. This is accomplished by incorporating the name in each subsequent document as a HIDDEN input element. This information is made available to the program that performs the exam generation or evaluation tasks (Figure 7.08).

Another HIDDEN input is used to label exams. Because anyone can take the chemistry test anywhere in the world, each exam is uniquely labeled. This is accomplished by using the computer's system clock. Macintoshes keep track of time beginning at midnight, January 1, 1904. One system value that Macs have available is the number of seconds that have elapsed since that moment in time. That number of seconds becomes a unique, and therefore identifying, number when used in a computer program that takes more than one second to generate a chemistry exam. Each exam is labeled with a string consisting of the letter "X" followed by the number of seconds between midnight, 1/1/1904 and the time the exam was created. This label is carried in the exam document as a HIDDEN input element.

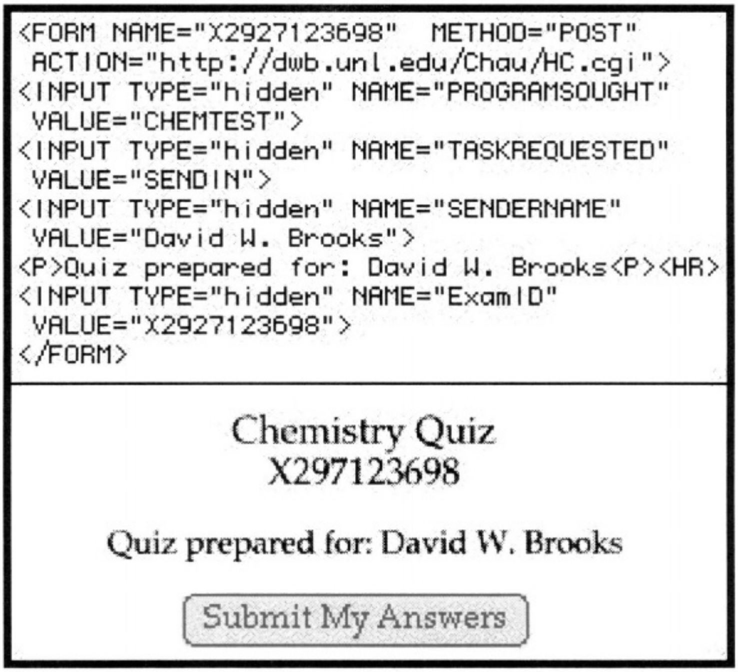



**Figure 7.08. Uses of the HIDDEN form element in coding exams. Top, the four HIDDEN elements will be transferred with other form entries when the form is submitted. The form has been set up so that, as shown in the screen capture at the bottom, two of the four HIDDEN items are shown directly in the form at the client side. All HIDDEN items, not just those visible, are submitted with the form inputs.**

## Mutually Exclusive Choices

A RADIO button element enables mutually exclusive choices. That is, checking one of the buttons precludes checking any other button in the family. A straightforward example is that of male/female where the choices are regarded as mutually exclusive (Figure 7.09).

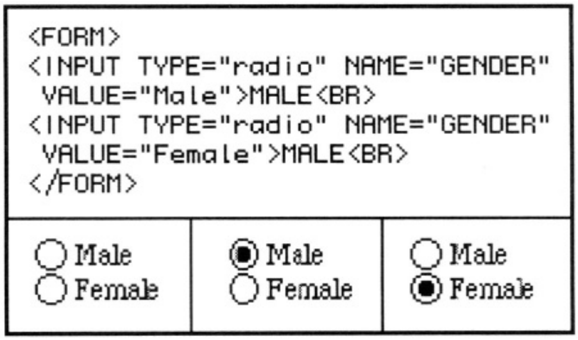



Figure 7.09. Top, HTML for creating a radio button entry in a form. Bottom, screen capture of that radio button entry in a form; first blank, and then filled in. Clicking "Female" in the middle example brings up the right-hand example, with "Female" on and "Male" off.

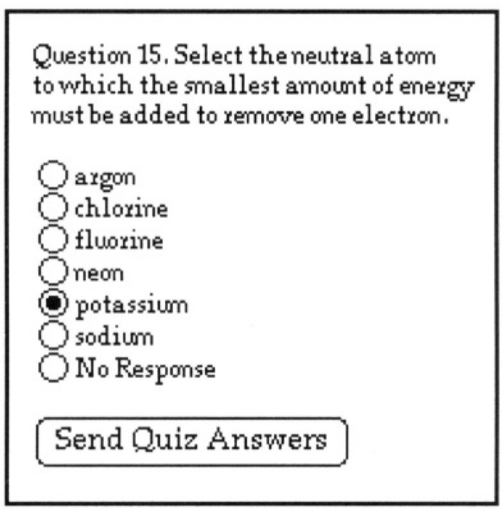



Figure 7.10. Using RADIO buttons for a multiple-choice test.

One of the buttons can be set "on" when the page appears. Clicking any one of these buttons causes any other button with the same name to be turned off. RADIO buttons offer a method for asking multiple-choice questions (Figure 7.10).

## Options

The CHECKBOX element allows a simple indication of yes/no or true/false for items which are not mutually exclusive. So, for example, when ordering a hamburger one might have an order that looks something like Figure 7.11. This could be included into a more typical exam-type situation (Figure 7.12).

```
<FORM>
<B>Hamburger Order</B><P>
<INPUT TYPE="radio" NAME="Bun" VALUE="White"
CHECKED> White
<INPUT TYPE="radio" NAME="Bun" VALUE="WholeWheat">
Whole Wheat<P>
<INPUT TYPE="checkbox" NAME="Cheese" VALUE="ON">
Cheese<BR>
<INPUT TYPE="checkbox" NAME="Mustard" VALUE="ON">
Mustard<BR>
<INPUT TYPE="checkbox" NAME="Catsup" VALUE="ON">
Catsup<BR>
<INPUT TYPE="checkbox" NAME="Mayo" VALUE="ON">
Mayo<BR>
<INPUT TYPE="checkbox" NAME="Tomato" VALUE="ON">
Tomato<BR>
<INPUT TYPE="checkbox" NAME="Lettuce" VALUE="ON">
Lettuce<BR>
<INPUT TYPE="checkbox" NAME="Onion" VALUE="ON">
Onion<BR>
</FORM>
```

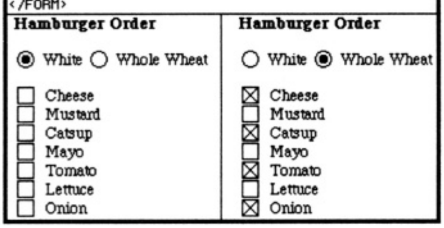



Figure 7.11. Top, HTML for creating a text entry in a form with RADIO buttons to choose type of bun and CHECKBOX elements to indicate condiments. Bottom, screen capture of those RADIO buttons and CHECKBOX elements in the form.

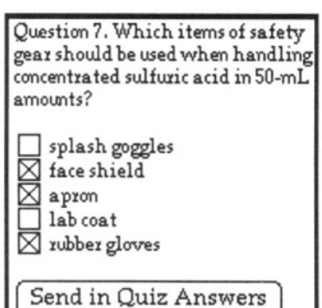



Figure 7.12. Using CHECKBOX items for a multiple-choice test.

## Multiple Options

SELECT is a form element with a menu-style choice. The user must click on the "select" bar and drag to the desired choice, releasing once the choice is made. There are no pre-defined clues about using this form input element; experienced users have encountered them more than once (Figure 7.13).

This input strategy can be used instead of radio buttons in multiple-choice situations. Instead of having a list of majors as in Figure 7.13, you can use a list of answers. You may set a default item, an item that comes up checked. We chose chemistry as the default item in Figure 7.13

Unlike RADIO buttons, SELECT can be set to accept multiple selections. The user must know that holding the Command-Key (or Control-Key in Windows) down and clicking a choice turns that particular choice on or off independent of others, making multiple selections possible (Figure 7.14).

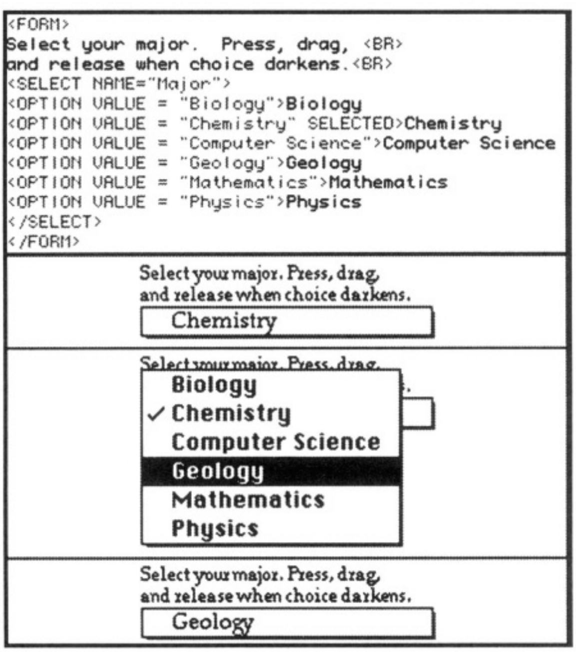



**Figure 7.13. The SELECT form element permits selection from a pop-up list of choices. One of the choices can be made the default choice by labeling it SELECTED in the HTML. Top, HTML for the select element in the form. Second, as it first appears. Third, appearance when pressed and dragged to choose "Geology." Bottom, after "Geology" selected.**

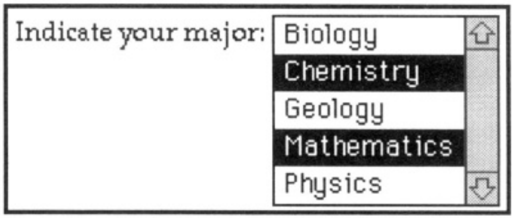



Figure 7.14. Screen capture of SELECT form element when two items have been chosen.

## Sending Inputs

SUBMIT is a form input element required to tell the browser software when the user thinks the form is complete and should be submitted for processing. Submitting answers that a learner has added to a form is a key feature of interactivity. In the absence of some scripting or Java application, there is no way for the server to poll the client, nor is there a way for the client to send some preview of the information being created to the server. There is only one attribute to set within the submit button tag, what the button actually says (Figure 7.15). The manner of submission is determined by the ACTION attribute within the FORM tag which begins the form.

```
<FORM METHOD="post"
 ACTION="http://dwb.unl.edu/HC/HC.cgi">
<INPUT TYPE="submit"
 VALUE="Please Grade My Exam">
</FORM>
```


Figure 7.15. Top, HTML for creating a SUBMIT button on a form. Bottom, screen capture of that button. Be explicit about the wording used for the button; have it serve your purpose.

## Clearing Entries

RESET creates a button that empties all of the form inputs except HIDDEN, and resets any preselected choices to their default values. This provides an action for cleaning up. Most of the time, the user is sent a form fresh from the server, and never gets to use this button. Besides, it is a rather dramatic event,

since all of the entered information is erased. Most users would usually prefer to erase just one or a few items in a large form. Again, the teacher can add special text for this button. When choosing text, it is better to be informative than cute (Figure 7.16). The danger of the RESET button is the student might accidentally clear all answers on a long form. Unless a need to erase all answers exists, don't include a RESET button.

```
<FORM>
<INPUT TYPE="reset" VALUE="Erase My Entries">
</FORM>
```

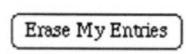



**Figure 7.16. Top, HTML for creating a RESET button on a form. Bottom, screen capture of that button. Be explicit about the wording used for the button; have it serve your purpose.**

## COLLECTING STUDENT TEXT

If lengthy responses are intended, consider alternatives to forms. Modern course management software (Chapter 3) affords students the opportunity to submit extended written assignments online. Another alternative is to employ some common multi-platform word processing application program (or a predetermined group of word processors), and have students create documents using that software. They can then send the document to you as an **attachment** to an e-mail. Much of the editing of this book was accomplished by e-mail exchange of attached documents.

## E-MAIL (FOR PROCESSING FORMS)

E-mail is not the most effective way to handle information received from forms. In fact, the *HTML 4 Bible* [Pfaffenberger & Gutzman, 1998] recommends against using e-mail except in cases where further processing is unlikely. However, e-mail beats nearly any conventional approach for teachers currently receiving student materials conventionally, say by heaping papers on the teacher's lectern at the end of class. The feedback comes straight to your electronic desktop.

In the FORM tag, an ACTION must be defined for the form input. By using "mail to:" followed by your e-mail address, the ACTION causes the form to be e-mailed to your address when the SUBMIT button is pressed. An example of a FORM tag with an ACTION **attribute** is:

<FORM Name="MyForm" METHOD="post"
action="mailto:jsmith@yourU.edu"enctype="text/plain">

The following four figures illustrate submission be e-mail. Notice the FORM tag in Figure 7.17 does not include the attribute "enctype='text/plain'" which was included above (see Figure 7.18). Without that attribute, the e-mail file will be difficult to read (see Figure 7.19).

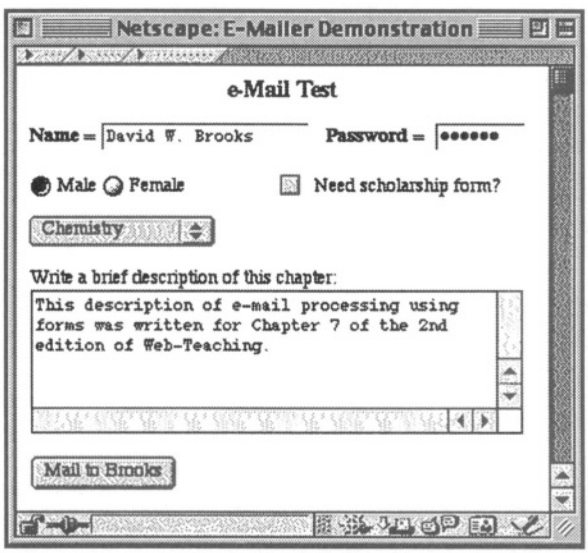



Figure 7.17. Web page created to illustrate e-mailing of forms. The form was opened using a browser, filled out, and the "Mail to Brooks" button clicked. Without ever posting the information to the server, e-mail was sent.

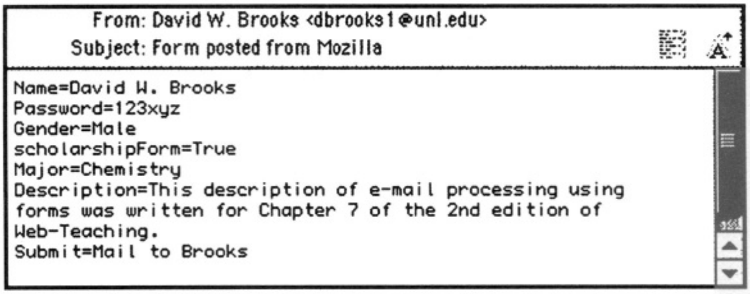
```
<html>
<head>
<title>E-Mailer Demonstration</title>
</head>

<body bgcolor="#FFFFCC">
<h3 align="center">e-Mail Test</h3>
<form method="post" action="mailto:dbrooks1@unl.edu">
  <p> <b>Name = </b> <input type="text" name="Name">
     
<b>Password = </b><input type="password" name="Password" size="8">
  <p>
    <input type="radio" name="Gender" value="Male" checked>Male
    <input type="radio" name="Gender" value="Female">Female
            
            
    <input type="checkbox" name="scholarshipForm" value="True">
    Need scholarship form?
  <p>
    <select name="Major">
      <option value="Biology">Biology</option>
      <option value="Chemistry" selected>Chemistry</option>
      <option value="Geology">Geology</option>
      <option value="Physics">Physics</option>
    </select>
  <p>Write a brief description of this chapter:<br>
    <Textarea width="45" height="5" wrap="VIRTUAL" cols="45"
     rows="5" name="Description">Write description here.</textarea>
  <p>
    <input type="submit" name="Submit" value="Mail to Brooks">
</form>
</body>
</html>
```

Figure 7.18. The HTML coding used in the form, Figure 7.17. Note the enctype='text/plain'" attribute is missing.

```
Name=David+W.+Brooks&Password=123xyz&Gender=Male&Major=Chemistry
&Description=This+description+of+e-mail+processing+using+forms
+was+written+for+Chapter+7+of+the+2nd+edition+of+Web-Teaching.
&Submit=Mail+to+Brooks
```

Figure 7.19. When the e-mail is received, it consists of an attached form saying that a file has been received from "Mozilla," the name often used by programmers for Netscape. This example was opened with file editing software, and wrapped into 4 lines. It comes in as a single line, heavily encoded, with all spaces replaced by "+" signs. Software exists to decode, but the use of the enctype="text/plain" attribute eliminates the necessity for decoding.


From: David W. Brooks <dbrooks1@unl.edu>
Subject: Form posted from Mozilla

Name=David W. Brooks
Password=123xyz
Gender=Male
scholarshipForm=True
Major=Chemistry
Description=This description of e-mail processing using forms was written for Chapter 7 of the 2nd edition of Web-Teaching.
Submit=Mail to Brooks

Figure 7.20. **When the enctype="text/plain" is used in the FORM element, the e-mail message appears as shown here. Note that the password field shows up as ordinary text. When a checkbox is unchecked, no information comes in.**

## THE LAST MINUTE

Just-in-Time Teaching (JITT) {U07.04} is a very useful teaching strategy in which the teacher purposefully waits until the last minute before completing preparations for class. Web-based forms are the most commonly available mechanism for obtaining the feedback needed to shape the lesson in Just-in-Time Teaching.

The key dimension of JITT involves having students complete a brief, Web-based assignment (called a WarmUp) within a few hours prior to the class meeting. The instructor is able to obtain summary information about students' responses. This permits the instructor to modify the lesson plan for the classroom. It more or less ensures that students prepare for class. It gives the teacher a chance to "begin where the behavior is at." The assignments provide information such that the instructor is able to start where the students are beginning to have serious trouble. It avoids unnecessary review, and, at the same time, avoids starting beyond the students' current levels of understanding.

Although the name implies procrastination, the reality of this method is quite to the contrary. The success obviously depends upon finding those "warmups" that provide incisive information regarding where student difficulties lie. Getting these ready, putting them on the Web, and analyzing the responses in a timely if last minute fashion requires a significant teacher commitment. The early results are encouraging, but the demands upon the teachers achieving these results are very high.

The strategy is reminiscent of one described over two decades ago by Shakhashiri [1975] in which brief, in-classroom, multiple-choice, paper-form-based quizzes were computer scored in batch-mode, and the results used for a variety of pedagogical purposes. We've come a long way as the result of using interactive Web technologies!

## GLOSSARY

attach: to add a copy of a document (attachment) to another document so that the first acts as a carrier for the second.

attribute: in HTML programming, attributes are settable properties of elements.

elements, HTML element: in HTML programming, an element is contained between a pair of tags. As used in this Chapter, elements are entities contained with the FORM element.

FORM: an HTML tag that permits incorporation of interactive elements such as text fields, radio buttons, and checkboxes into an HTML document (Web page).

image map: an image with embedded clickable hot spots that serve as hyperlinks.

wrap: lines that start a new line when they texts comes to the end of the screen. Without wrap, the right side of long lines can be invisible off the screen.

## REFERENCES

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U07.03. Creating a Test Using Only Links, http://129.93.84.115/WebT/TestByLinks/LT.html (accessed 4/5/00).
U07.04. Just-in-Time-Teaching: Active Learner Pedagogy with WWW, http://webphysics.iupui.edu/JITT/ccjitt.html (accessed 4/24/00).

# CHAPTER 8

# Multimedia Beyond Text

## VISUAL MEDIA

Images have played a key role in scientific textbooks for centuries. Galileo used illustrations in his manuscripts during the mid-1530s. Century-old science textbooks include illustrations that are black-line drawings. Some of these are marvelous in the way they illustrate complex concepts. Thirty years ago color in texts was often restricted to one signature, that is, a group of pages that were manufactured together during printing process. Modern textbooks, especially those aimed at large audiences, are usually multicolored affairs. Even the printed text is emphasized using color to code words.

Visual images aid in learning. The capacity for pictorial memory exceeds that for verbal memory [Shepard, 1977; Standing, 1973]. The neurological mechanisms underpinning human storage of memories of pictures do not include either models in which individual images are stored as if in a museum gallery, or strings of 0s and 1s. Biederman [1987] has proposed a recognition-by-components model. Using images to teach is nothing new [Willows & Houghton, 1987]. There are some situations, i.e. with beginning readers, where pictures not only slow reading, but pictures unrelated to the text produce interference [Willows, 1978]. However, the conclusion of considerable research on the use of charts, graphs, and diagrams indicates that they can convey information uniquely in ways not possible for text [Winn, 1987]. Mayer has pursued this area and developed some explicit guidelines regarding the nature of illustrations successful in enhancing learning [Mayer & Gallini, 1990].

Modern Web browsers readily accommodate images and other forms of media. Web-delivered media can be so complex that one needs to be concerned about cognitive load – and to be sure that a learner's cognitive resources are working synergistically rather than antagonistically with the learning materials

provided. Sweller and colleagues [Sweller & Chandler, 1994; Mousavi et al., 1995; Cerpa et al., 1996; Sweller, et al., 1998] address the design issue of matching cognitive load to cognitive resources.

Images for the Web come from a wide variety of sources. They can be captured by **digital cameras, scanned** from photographs, produced on **Photo CDs,** brought in as single frames from video sequences, obtained from outside sources, or produced electronically using graphics or other specialized software (e.g., *Geometer's Sketchpad* {U08.01}, *ChemDraw* {U08.02}).

## STILL IMAGES

We often forget that, inside our computers, all information ultimately is represented as strings of 0s and 1s. This also applies to images. To make sense of these strings, developers have created formats - ways to interpret strings of 0s and 1s so appropriate **pixels** on a computer screen are lighted and an image appears.

There are three main file formats commonly used for still images on the Web: **GIF**, **JPEG**, and **PNG**. Moving images can be produced with animated GIFs, several versions of **MPEG** (a format related to JPEG), or streaming video; further discussion of moving images appears later in this chapter.

A few basic concepts are important to understanding the different formats. Particularly the ideas of compression, **lossy** versus **lossless** compression, **interlacing,** and **thumbnails.** Because images are made up of individual pixels on the screen, image files can be extremely slow to download because they are so large. Even with the continually increasing speed of Web connections, especially with the increase in Web congestion, downloading image files can be very time consuming. Compression of files speeds file transfers.

### Compression

Because computer files of pictures, movies, and sounds are very large compared to text files, developers have designed ways to make the files smaller. Image files are saved by taking the information in the image and compressing it. An image that is 8 pixels by 8 pixels contains 64 total pixels, every pixel has multiple characteristics – color, hue, intensity to name just a few. If every characteristic of every pixel were recorded individually, even an 8 pixel by 8 pixel image would be a large file. The answer is to compress the file. A grossly simplified example would be to record that the first through sixth pixel in the second through fourth rows of pixels are all a particular color, hue, and intensity. Compression procedures can be lossless or lossy.

Lossless compression occurs when every pixel is recorded and the image can be precisely reconstructed from the compressed data. Lossless compression

requires the files be sufficiently large to include all the possible data. A compressed file of 64 pixels with all pixels different would be the same size as the non-compressed file. But, since most images actually have large areas that are identical, even lossless compression usually represents a major saving in file size.

Lossy compression goes a step further and saves the image without saving the data for every single pixel. It samples the pixels, and saves a reasonably representative set of pixels. Lossy compression can trade quality of picture for size of file. As the quality of the saved image improves, the size of the file increases. Since lossy compression decreases the total amount of information, files that are compressed and saved have less data than the original. Repeated compression will degrade the image. Nearly all video compression is lossy. Some still image formats are lossy, while others are lossless. Maximizing compression minimizes download time, but maximum compression leads to loss of data.

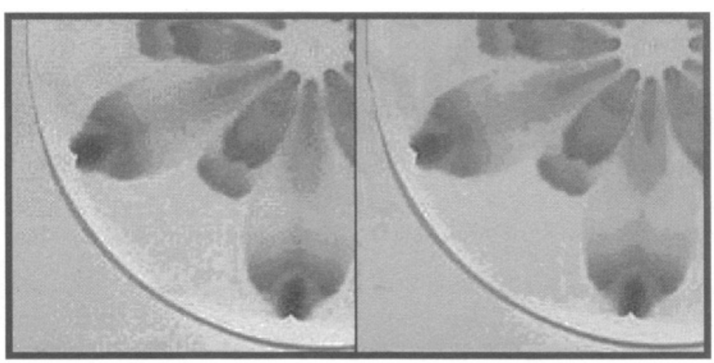

**Figure 8.01. Information can be lost during compression for many reasons. This illustration was constructed from a JPEG image (left) and a GIF image (right). To render the large variety of colors of the original adequately, more colors were needed than could be provided by GIF. In color, the image at the right appears blotchy or pixelated relative to that at the left. This blotchiness carries over in the grayscale image.**

## Interlacing

To make images understandable as quickly as possibly during download, they are often **sliced** into pieces and interlaced while transmitting them. Interlacing sends the sliced image in an alternating order, providing a fuzzy version of the image quickly. As the image continues to load, it becomes more

clear. The exact manner of slicing and interlacing affects the speed with which the image becomes understandable.

**Thumbnails**

When it is necessary to have a large number of images available, one way to minimize the time for download is to create thumbnail versions of the images (see Figure 8.02). The thumbnail images can be created with little concern for loss of data; the user clicks on a hypertext title or even on the thumbnail itself to download the full version.

Careful use of thumbnails and hypertext links to larger files can minimize the download time for a **Web page.** If students all need to view the full-size images, consider breaking the document into multiple, smaller documents rather than using thumbnails.

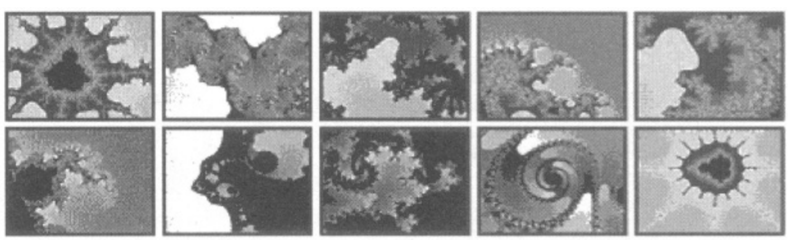

**Figure 8.02. Thumbnail index of fractal images. Screenshot of The Mandelbrot Gallery {U08.03} The site stores these as GIF images, but JPEG images can also use thumbnails to minimize download time in pages.**

**GIF**

The GIF format (Graphics Interchange Format, pronounced like the peanut butter), developed by CompuServe, was the original format used for still images on the Web. GIF uses a lossless form of compression; images may be saved, restored, and saved again with no degradation. GIF is excellent for line art (logos and basic illustrations), icons, graphs, and lettering. The GIF format permits up to 256 colors. When interlaced, GIF images and embedded lettering appear fuzzy until nearly finished loading.

Photos saved in the GIF format may appear washed out or smudgy; photos are best handled with other formats. Software to create GIF images is readily available. There are several sources of downloadable GIF applications such as *GIFConverter* {U08.04}.

## JPEG

The JPEG (Joint Photographic Experts Group, pronounced JAY-peg) format provides the ability to display millions of colors, and to compress the file for speedier transmission across the Web. JPEG was designed mainly for use with photographic and lifelike images. JPEG is a lossy form of compression; the degree of loss can be varied when saving in JPEG format. Quality can be traded for speed, or vice versa. Creation of thumbnail versions of images for indexing on a Web page can allow use of multiple JPEG images without sacrificing download time (see Figure 8.02). These thumbnails can be clickable to access the full size pictures. Since the image compression produced by JPEG is lossy, any editing of the image should either be accomplished before conversion to JPEG, or the file should be converted to PNG and edited within that format before being returned to JPEG. Repeated compression and decompression within JPEG degrades the image rapidly. Software using the PNG (Portable Network Graphics, pronounced "ping") format can be used for editing of images prior to conversion to JPEG or between a decompression and compression.

JPEG uses a two-dimensional interlacing, so print embedded in images becomes clear sooner during the download process. GIF images should not be converted directly to JPEG; too much detail will be lost.

## PNG, MNG

The PNG format (Portable Network Graphics, pronounced ping) uses lossless compression. It can be saved, viewed, and saved again without degradation. It was developed in response to copyright issues concerning GIF, and is widely regarded as an improvement on GIF. PNG has a better maintenance of color between and within platforms. It includes the ability to have variable transparency on the pixel level (254 levels of partial transparency), slightly better compression than GIF (5% to 25%), and two dimensional interlacing so text embedded in a downloading image is readable about twice as fast as in a GIF image. Like JPEG, PNG supports true color. PNG serves as the native format for many of the best new graphics programs (e.g., *Fireworks* and *PhotoShop* use PNG, and then allow for export of the image to GIF or JPEG).

At the time of this writing, PNG is not completely supported by either *Communicator* or *Internet Explorer.* However, it is expected to be completely supported by both soon. If you want to use PNG images directly in your Web pages, be sure to test them on a variety of browsers and platforms. Willem van Schaik's PNG test page {U08.05} can be used to determine if a browser properly handles many of the features of PNG.

PNG does not support animation; the related format, MNG (Multi-image Network Graphics), is emerging. MNG {U08.06} is intended to support animations.

## The Image Tag

To insert an image into an HTML document, use the "image" tag. Within the tag, the source attribute (src) tells the browser where to find the image file. Other attributes, such as width and height in pixels, may also be included in the image tag.

<img src="Ch08-04.gif width="150" height="150">

## Creating Artwork

Often **bundled** with a computer's "accessories" software, **draw** and **paint** programs are the most basic types of artwork programs. There is a fundamental difference between drawing and painting. With paint programs, the user creates an image that is saved pixel-by-pixel (i.e., screen dot by screen dot). Painting allows for detailed, pixel-by-pixel editing which is useful for creating subtle variations in images. In draw programs, the images the user creates are saved as equations – hidden from view – that recreate the image. Because each part of the image is saved as an equation, editing is simple, and files are smaller. Editing is a simple matter of clicking on images and using the "draw tools" to manipulate them.

For flexible creation of artwork, a versatile package such as Macromedia's *Fireworks* {U08.07} combines the characteristics of draw and paint applications, and expands on their capabilities. Special effects are just a click away. *Fireworks* also allows the image to be saved in a variety of formats, resolutions, and sizes.

## Photographs

There are numerous ways to capture photographs for Web use. Photos can be scanned; film processors can provide a digital version of pictures at a minimal cost; frames can be captured from video. Digital photography, however, has revolutionized the use of photos on the Web. If the desired illustration can be photographed, the use of a good digital camera can make the process of acquiring the photos quick and relatively inexpensive. Although digital cameras can be more expensive than film cameras, the savings in time and cost of film and developing can quickly make up the difference. Software such as Adobe *Photo Deluxe* can make the manipulation of digital images quick and simple.

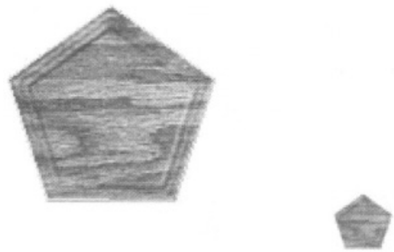

**Figure 8.03. Left, a 9K image created in *Fireworks*, a hybrid art program that combines the attributes of draw and paint programs and expands upon them. Right, a thumbnail of the image also created in *Fireworks*, the thumbnail gives a close representation of the original, but uses only 2K.**

## Digital Still Cameras

Digital cameras have come into their own since the first edition of *Web-Teaching*. The features and capabilities of these cameras have become competitive with standard cameras, as have their prices. Camera prices range from the very inexpensive ($64 for a functioning toy camera) to the very expensive professional grade models costing upwards of $10,000. A good, basic digital camera can be purchased for as little as $100 for the AGFA ePhoto Smile {U08.08}. A digital camera with enough features to satisfy most Web designers runs from $300 up to around $1000 at the time of writing.

The digital camera market is changing fast, as most technology markets do. Any specific recommendation which could be made here would be out of date prior to publication. When shopping for a digital camera, several things need to be taken into consideration. The quality of the images is very dependent on the resolution, but if the camera is exclusively for use with a Web site, extremely high resolution cameras may be unnecessary. If images need to have very minute detail, higher resolution may be desired. Camera manufacturers use any of several storage strategies. Some cameras use memory cards; some cameras use floppy discs.

*Digital Photography Review* {U08.09} provides a Web glossary page for digital cameras. The Bogus HAL 9000 {U08.10}, a mythical camera, is used to explain the terminology used in the Digital Eyes Imaging Search Engine {U08.11}.

## Scanners

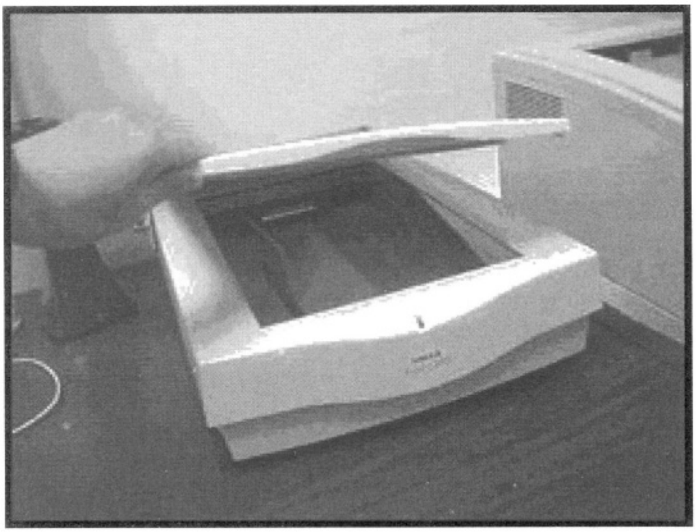

Figure 8.04. Scanners of excellent quality, used to scan artwork and text are readily available.

Existing photos and artwork can be converted to digital form quickly using a scanner. A flatbed color scanner can be purchased for less than $100, with top-of-the-line models still costing well over $1000. The low-end scanners may be adequate for most Web design. Scanners are usually bundled with software for scanning images and some form of optical character recognition (OCR) software which converts a scanned document into a file such as a text, word processor or spreadsheet file. Scanners need to be compatible with your platform (Mac, Windows, or other), and must use the right type of connection (parallel, serial, or USB port) for your computer.

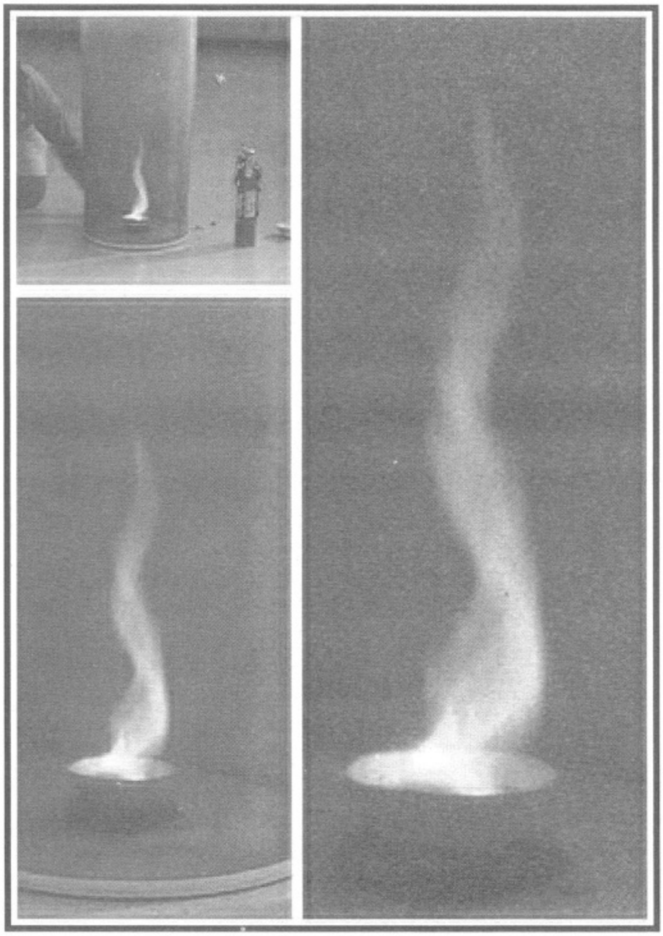

Figure 8.05. **Five resolutions are available from a Kodak Photo CD. Top left, 192 x 128; bottom left, 768 x 512; right, 1536 x 1024. Two other resolutions (384 x 256; 1536 x 1024) are available. Taken from *BeckerDemos*-CD, Synaps Chem Tools.**

## Photo CDs

Film remains an excellent way to capture still images. Digital photographic equipment increasingly replicates the features of non-digital equipment, but the non-digital may still have benefits for some. An easy way to use the traditional methods and equipment of photography is to request digital versions of images at the time of processing. These images may be obtained on inexpensive floppy

disk format or on Kodak Photo CD {U08.12} format. The Photo CD is a bit better; for Web site development, you probably want a Photo CD.

The Kodak Photo CD also offers a simple way to convert slides, negatives, and even flatwork (printed pictures) to digital form. Existing slides or film negatives can be sent to a photo lab for transfer to a Photo CD.

The standard Photo CD can hold about 100 images. It comes with a numbered thumbnail color image that permits quick review of the images to locate any particular desired image. Software on the Photo CD permits you to examine each photo. Five different image resolutions are available. The greatest resolution demands enormous amounts of memory, and provides what is tantamount to magnification of the image. Software designed for a variety of graphical image uses (e.g., *Photo Deluxe, Photoshop,* or even *Fireworks*) can be used to adjust and edit the image.


**Figure 8.06. Webcam view of construction site taken 2/17/00.**

Using an appropriate board or other converting device, single frame video images (analog output) can be converted into digital still images. This technology used to be a mainstay, and may be the best way to extract still images from existing video resources. With digital video, frames are captured using the editing software.

An interesting, popular, and inexpensive solution for some situations is a small camera mounted atop the computer. These devices usually come with software that permits capturing a single frame. A computer mounted Webcam

can provide intermittent pictures of something you want to keep an eye on, like this construction site. (Figure 8.06.)

## SPECIAL PROGRAMS AND PLUG-INS.

Visuals developed for the Web can be information rich, esthetically rich, and interactive. Graphs, once created with great effort, are now handled easily through desktop computers. Morphs, multiple images representing the metamorphosis of one image into another, once were essentially impossible to create. Overlays and multiple exposures were possible, but stepwise transformations of one image into another required careful artwork and enormous effort. Morphs now are created easily on a desktop computer.

Many special programs and plug-ins are available for specific disciplines and uses. Chemists and chemistry students use programs to create images of molecules; architects and landscape designers use computer-assisted design programs (CAD); mathematicians use programs to perform calculations and create images.

### Graphs

Spreadsheet programs are the computer tools most commonly used to construct graphs. Data which has been entered in the spreadsheet can be organized into a wide variety of graphs and charts with just a few clicks. Graphs may be captured from screens, edited in a program like *Fireworks,* and pasted into a Web page as an image.

For those who need more specialized graphing capabilities, high power graphing applications such as *DeltaGraph,* or *Kaleidagraph* are designed to construct multiple forms of complex graphs. *Kaleidagraph,* available for both Macintosh and Windows (files may be transferred cross-platform), provides a powerful, but relatively inexpensive 2-D graphing tool for the scientific community. It includes several built in macros to perform operations such as the generation of random numbers. It includes built-in fits for linear regression and smoothing, plus over 100 industry-specific formulas. *DeltaGraph* has similar capabilities to *Kaleidagraph,* but puts more emphasis on the presentation aspects of charts and graphs.

Several applications dedicated to specific subject areas include charting and graphing capabilities. These images can sometimes be added directly to a Web page, otherwise they may be captured as a screen shot, edited, and pasted in as an image.

Programs are available that allow students to download software to their graphing calculators (TI-*Graphlink),* either from other calculators or from computers.

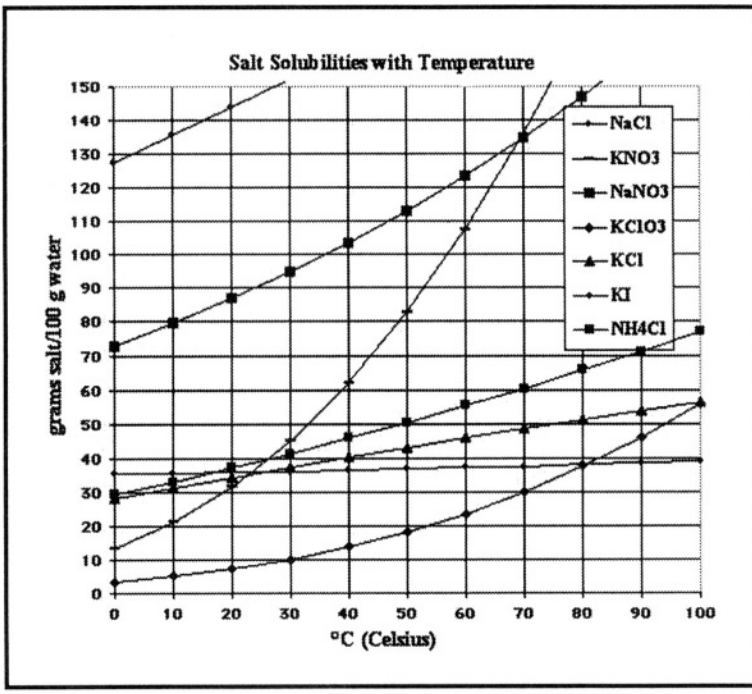


Figure 8.07. Screen capture of salt solubilities calculated using a 3-parameter equation and displayed for 7 salts, created using Microsoft *Excel*.

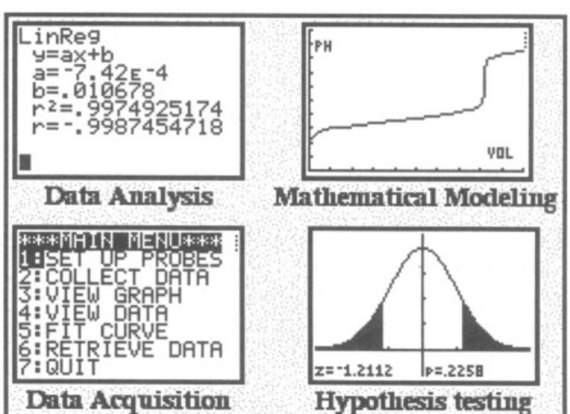


Figure 8.08. Screens from graphing calculator captured using TI-*Graphlink*.

## Virtual Reality

Visual aspects of virtual reality are coming more and more to the fore. Software has been developed that will permit you to tour a museum. You can interact with visual information that will take you "into" the museum. Once "inside," you can turn around to see the choices or options of where to go, and choose a hall or exhibit area. You can seemingly walk here and there and, when inside a particular gallery, scan its contents. You can "walk up to" (zoom in on) individual exhibits in the museum. Figure 8.09 is a virtual reality movie of a teaching laboratory {U08.13} at the University of Nebraska-Lincoln. It was produced by Elizabeth Petrakis over four years ago. To manipulate the image in Figure 8.09 you need to have a suitable *QuickTime* plug-in located in the plug-ins folder of your client browser software.

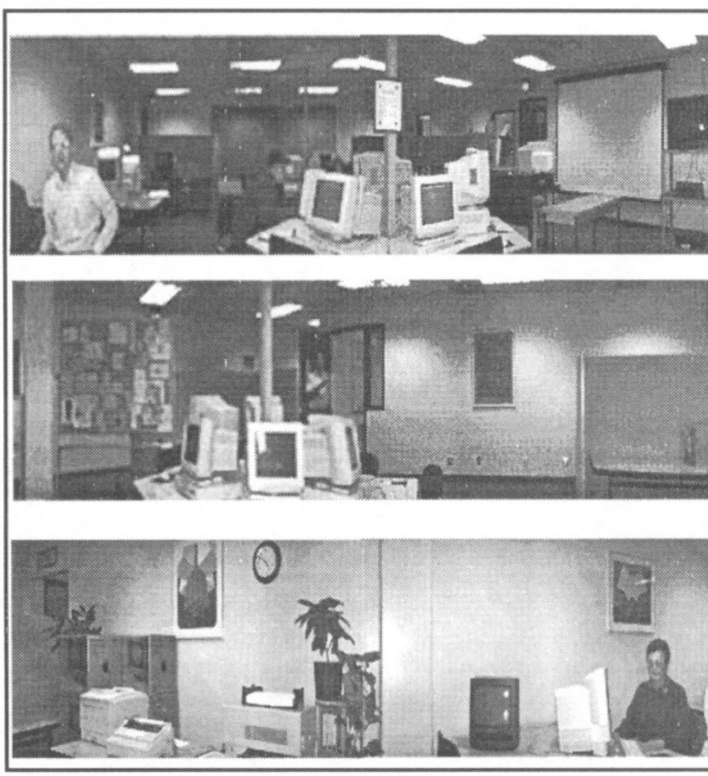

**Figure 8.09. Virtual reality movie of teaching laboratory at the University of Nebraska–Lincoln. All three pictures come from the same visual. It appears on most computer screens in about the same size as one of these print images.**

Virtual reality can take the form of images stitched together to create a 3D view, or images forming movies, allowing the viewer to "move" through the scenes. Petrakis placed a digital still camera on a special tripod and captured images sequentially as the camera was rotated through 15-degree increments. These images were then stitched together to create a file that is interpreted by *QuickTime.* By dragging the cursor, a virtually continuous display is presented as if one were standing in the center of the laboratory and continuously turning around. The rate is determined by the extent of the mouse gesture. This is something you must see to believe. It can crawl, or it can spin at a dizzying rate.

### *Chime*

There are several chemistry programs for creating images of molecular structures. These may be represented in any of several ways, such as with letters (alphameric characters) representing atoms and lines representing the chemical bonds between atoms (or with three-dimensional, touching, overlapping spheres representing molecular structures).

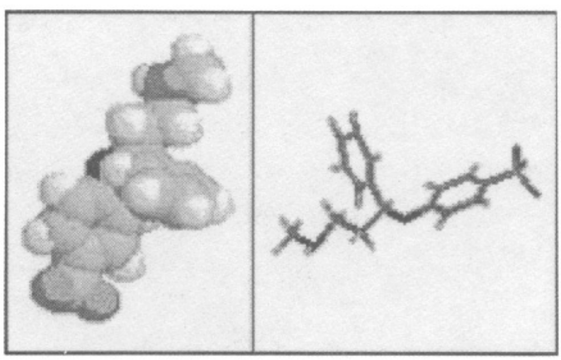

**Figure 8.10. These images represent the chemical structure for the drug, prozac. The Chime plug-in allows the user to rotate the structure in any direction, and change the form. This tool replaces much of the work that previously required the construction of actual models from spheres and sticks. *Chime* is well described at a Cabrillo College {U08.15} Web site.**

Creating images such as those in Figure 8.10 used to involve literally constructing physical models and photographing them. Today building such representations using software takes an experienced user seconds. *Chime* allows the same information file used to create the images to be manipulated using the *Chime* plug-in. So, the user has a great deal of control over the format and aspect for viewing the structure. To manipulate these images you need to have a

suitable *Chime* plug-in {U08.14} in the plug-ins folder of your client browser software. Unfortunately, *Chime* is fussy and does not work with all client browser software. To see a wonderful illustration of using this type of multimedia in instruction, visit the stereochemistry {U08.16} page of the Colby College Chemistry Department.

### 3-D; CAD

Computer-assisted design (CAD) programs can create very useful images for teaching, especially for technical disciplines. These images can be captured and displayed on the Web as GIF or JPG images. Modern CAD packages allow basic design in two dimensions with extensions into three dimensions, including rendering. Most modern architectural designs are rendered with CAD programs. Inexpensive CAD programs with limited features are available.

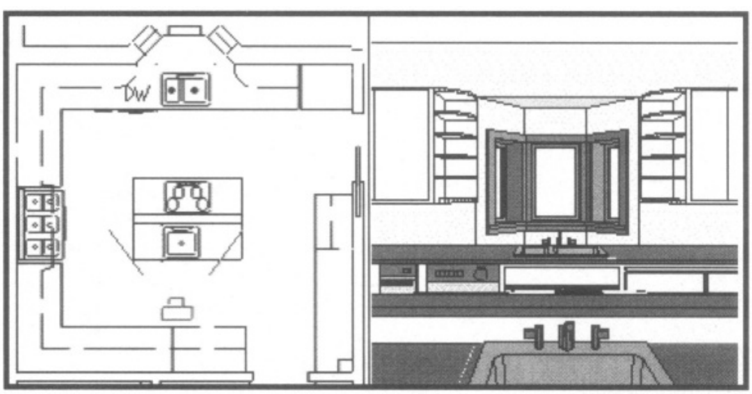

**Figure 8.11. Screen capture from *3D-Home Architect*. Left panel, a 2-D rendering of a kitchen plan, complete with a camera aimed toward the window. Right panel, a 3-D rendering of the kitchen from that angle.**

Some basic 3-D effects are now available in the drawing tools included in some wordprocessing applications. (Microsoft *Word* for Windows can take an oval and turn it into a tin can telephone! See Figure 3.01 in Chapter 3.) Companies marketing 3D and/or CAD programs are flooding the marketplace with products aimed at the Web. Some of these focus on the creation of images for use in Web documents.

### *Mathematica*

*Mathematica* {U08.17} is a very powerful program that performs mathematical operations. In its most recent incarnations, this program has become very sophisticated. When using *Mathematica* (Figure 8.12), teachers create "notebooks." Text and figures surround the functions of *Mathematica* in these notebooks such that users can vary parameters in the functions to display the outcomes. It is possible to download notebooks to the client's computer, making them not only visual, but also interactive. The user can access a file using a Web browser, modify parameters within that file, process the changes, and observe the outcome. This is a remarkably powerful feature, one likely to be expanded and emulated by many other programs.

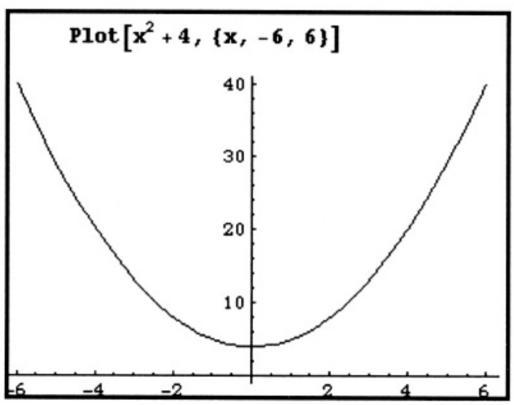


**Figure 8.12. Screen capture illustrating a graph generated using *Mathematica*.**

## IMAGES WITH MOTION

Motion affords visualizations that are difficult or impossible using other media. Movies represent a great challenge, however, since the necessary **bandwidth** (network capacity) is very large. As the bandwidth of the Internet grows, and ever faster desktop hardware includes more and more storage and **RAM,** video on the Web becomes more common. Video may be provided either in files which are downloaded or by streaming.

The quality of the movies produced for the Web continues to grow as the result of improved hardware and software. However, video is still very expensive in terms of system resources.

### Compression Standards

In order to work on the Internet, video must be compressed. Uncompressed, a three minute movie would be approximately four gigabytes. Uncompressed video takes so much bandwidth that accessibility would be restricted. There are several video compression standards commonly in use. M-JPEG {U08.18}, although not truly a standard (different companies achieve it through different methods), is used by the motion picture industry for initial recording and editing; M-JPEG compresses each frame, but keeps each separate. Further compression is needed for Web transmission. MPEG and MPEG-2 {U08.19} add compression between frames to provide a higher rate of compression, suitable for Web broadcast. MPEG-2 is the current standard for recording DVDs. The compression format used for QuickTime files is Cinepak. All video compression is lossy. Video quality quickly becomes an issue when the losses are large. MPEG compression can reduce the file size by up to 99%, depending on the images and the degree of lossiness that is acceptable.

### Movies

We use the term movie to describe moving images that are packaged into a file that will transfer from the server to the client.

The impact that **digital technologies** have had on media is nothing short of remarkable. The surrealism that greets viewers, made possible by computers, is spectacular. Also spectacular has been the decrease in video production costs. Not only is desktop video an achievable reality, but portable hardware and software packages are more than up to the task of creating outstanding video. One person can do in minutes what used to take several persons many hours, or even days, to accomplish. With digital video, desktop movie making is rapidly coming into its own. Excellent digital video camcorders are now very affordable.

Desktop video is not something to enter into casually. There is more to making movies than simply running a camera. A sense of production quality appropriate to the task does not come packaged with the equipment. Regardless, many teachers may know their own subject, but creation of quality video requires a larger set of design skills. Many teachers are undertaking their own video production. What teachers do bring to the task is a sense of the troubles students have when they encounter material. This knack for identifying the stumbling blocks is key in many situations.

Video must capture what is needed. The key visual information must nearly fill the video screen, and be devoid of any distracting visual information.

### Streaming Video

Streaming video is a file sent from a server and captured in a buffer but not stored permanently by the client. As soon as enough information has been received, the video starts. Usually, starting is delayed until a combination of the amount in the buffer and the rate of data reception suggest that the video will be played to completion without interruption. Streaming video usually is played from a server. Sometimes, however, live video is compressed and delivered nearly immediately – just seconds elapse between the live act and the transfer of the information stream to the Internet.

Some sort of software player that decompresses the data stream that is arriving and displays it as video is necessary. A player may be included in browser software, or can be downloaded from the Internet.

Most Web uses involve the client "pulling" material from a server. Streaming video is an example of a "pushing" technology wherein the server may transmit information without explicitly being requested to do so by the client. Streaming video is still evolving. RealNetworks {U08.20} is a company devoted to delivery of streaming video. Apple's *QuickTime* {U08.21} also supports streaming video. Both are available for both the Macintosh and Windows platforms. The software needed to play the files produced, *QuickTime Player* and *RealPlayer,* may be downloaded for free.

### Animations

An animation is a sequence of graphic images stitched together to form a movie. Animations are probably used as often as movies in teaching. Animated graphs, for example, provide clear indications of phenomena. Elegant animations specifically designed to actively illustrate complex concepts can be developed. John Markwell uses an animation of an electron transfer {U08.22}, part of photosynthesis, in his undergraduate biochemistry courses (see Figure 8.13). This animation was developed using Macromedia *Director.*

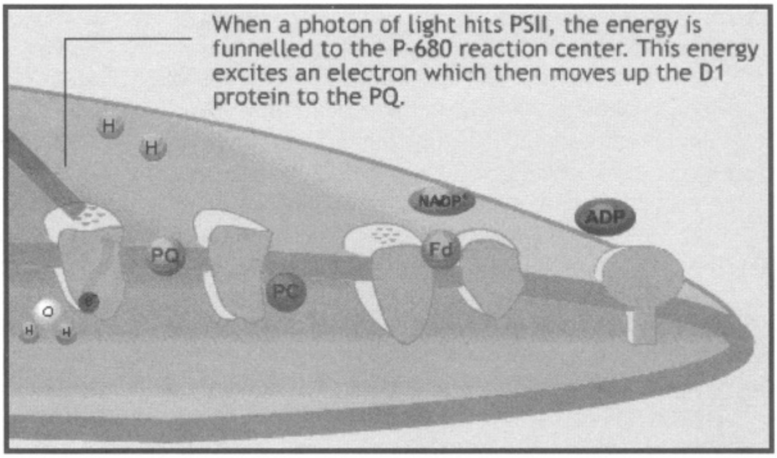


Figure 8.13. **Screen capture from animation of electron transfer during photosynthesis.**

One of the simplest forms of animation for the Web is the animated GIF, which consists of a series of GIF images stitched together using appropriate software. Figure 8.14 is an animated GIF taken from one of the author's Web sites.

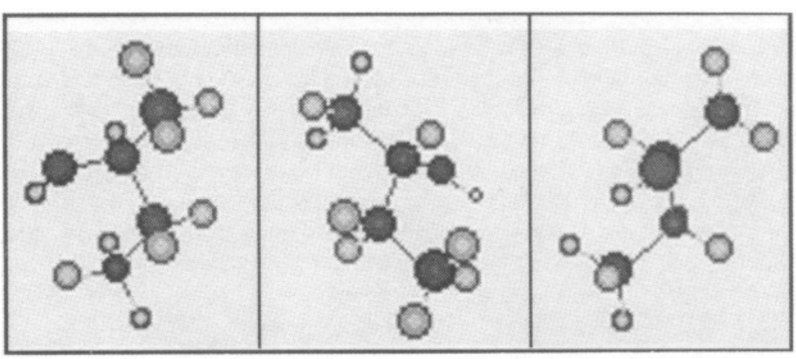

Figure 8.14. **One easy animation is accomplished by pasting a series of images together to make an animated GIF. This can be accomplished in *Fireworks*. The image above was created using *Chem3D* and rotations of about 15 degrees each. When stitched together into a new GIF file, the result appears as a movie. {U08.23}.**

### Hardware

If you make your own video, you'll need a digital videocamera. Digital video camcorders are now available for under $1000. Industry rumors suggest that a prosumer (professional quality for the consumer market) digital video camera for less than $2000 will hit the market shortly after this book goes to press. It is also possible to start with analog video, and use "capture" hardware that has been available for a decade. If you are starting out, however, we urge you to go digital from the outset. The most important aspect of video is image quality. Because compression is a necessary reality of digitizing video, each step leads to degradation. It is better to start with and preserve pixels as long as possible in the editing, and then compress at the last stage of production. Compression procedures almost always are lossy. A state of the art computer with adequate RAM and **drive space** are essential to the manipulation of video. Thirty minutes of uncompressed video can fill 40 gigabytes. Editing operations will require space for the original file, the new file, and the interim work.

### Software

Once the files of digitized video are on your hard drive, you're ready to begin the editing process. You will need to use some nonlinear videoediting software. Drive space and RAM can limit what you are able to do. For most operations, a one gigabyte drive and 48 megabytes of RAM specify a small system.

Software packages allow you to open and view video. You can easily cut off the ends of a sequence. You also can cut something out of the middle. Software recommendations printed in a book age remarkably quickly. At press time, software packages to look at include *Final Cut Pro* {U08.24}, Adobe *Premier* {U08.25}, and Avid Cinema {U08.26}. To reduce download times, compression becomes a critical issue when movies are going to be served on the Web. Software such as *Media Cleaner Pro* {U08.27} can be used to fine-tune movie compressions. You will need powerful editing programs that combine video, animation, still images, and graphics to bring your ideas to life.

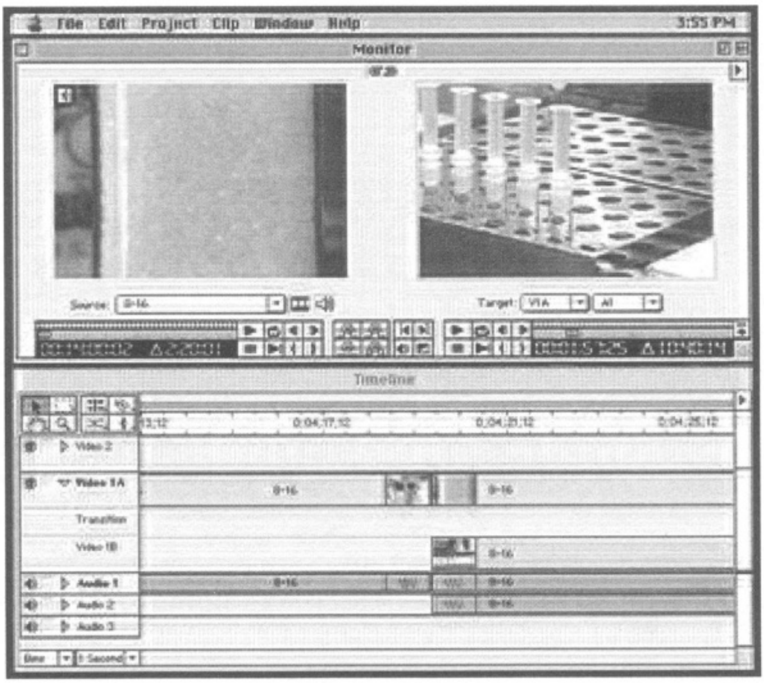


**Figure 8.15. Modified screen capture from Adobe *Premier* video editing software.**

Many visual effects are available to go from one segment to another as you edit them together. For example, you can use a cross-fade – where the first image fades to black as the second image comes up from black. Also, you usually can control several soundtracks at the same time.

As it happens, adding information to the video – titles, arrows, animated arrows, and the like – is quite a bit more complicated and beyond the scope of the simplest editing programs. Most teachers tend to overdo "effects." Remember, your video is embedded in a multimedia platform that can deliver information in many ways. Complexity cannot be avoided in most real-world situations. Recognizing an ecological relationship in the field is a great deal different than recognizing it in a clean video. For better learning, focus on the key points at first; then provide situations of increasing complexity.

## AUDIO MEDIA

There are at least five different ways in which sound can be used in multimedia programs:

- Earcons, sounds that indicate a particular operation
- Informational sound, the nature of which indicates some special meaning about the data
- Streaming audio, live radio-like sound
- Music
- Text to speech tracks in which text files are "spoken" in a computer voice

Sound is recognized as one of the emotionally most compelling media. It is the core means of human communication. A teacher can record the sounds made by a scientific instrument, or the calls of a bird, and put these to extremely good use. But in most Web-teaching situations, sound is not very useful.

A teacher can record lectures, and have these audio tracks available over the Web. For visually impaired students, this may be particularly helpful.

Remember, it can take nearly as long to download sounds as to download movies! In some situations, however, sound may be well worth using.

### Including Sound in Pages

Sound is a very complex area – nothing like delivering images where a few formats cover nearly all current situations and are available for nearly all platforms. If sound is mandatory for your pages, we recommend *Webmaster Expert Solutions,* by Morgan et al. [1996, Chapters 33 and 34] as a reference.

### Earcons

An earcon is a sound used to indicate some event or action. Computers play sounds when we mess up, or when e-mail arrives. Sounds can be used to indicate that a process is complete, that a new page has opened, that form information has been mailed, and so forth. Earcons often are built into hypermedia programs, and they are likely to find appropriate roles in Web-teaching.

### Sounds That Convey Information

John Flowers has experimented with the use of sound to convey information [Flowers & Haver, 1995]. In his work, as quantitative graphical information appears on the screen, there is an accompanying sound that informs the viewer

of a summary of the information represented in that graph. This is a potentially powerful multimedia application.

### Streaming Audio/Radio

Live audio is now broadcast over the Web. In the same way that video can be streamed, audio can be streamed. Many radio stations across the country have turned to streaming audio to increase their listening audience. If a real time broadcast of a lecture or event is desired, one way to approach the problem is streaming audio. A basic Web site can be converted to a virtual broadcast booth. A better approach might be to use streaming video, including a powerpoint-style presentation with the audio.

If spoken voice is important for learning, consider making a movie that consists of a series of still pictures with voice superimposed. In this “voice movie,” you can include several images. Make a video containing the desired speech, and replace the visual portion with still images using videoediting software. Alternatively, put an image in an HTML file, and link it to a corresponding sound file. If using stills with a video, make the inter-picture transitions slow cross-fades rather than abrupt cuts.

### Music

There are two things to keep in mind about music. First, it takes a long time to download music over a slow line. If speed of transmission is an issue in your teaching situation, think twice about including music unless that is what you are teaching. Second, be concerned about authorship and copyrights for background music. The best procedure is to pay a music student a small amount of money to create original music for you such that you own the copyright. Digital music in **MIDI** format is an effective approach.

### Electronic Text to Speech

The quality of text to speech on computers has been improving steadily. To our ears, it’s up to the level of poor, possibly fair, but less than good. If you feel that spoken words are essential, consider electronic text to speech as an option. If possible, try this on your target audience. Our experience is that students quickly learn to impersonate the electronic voices, and have a great deal of fun doing so. They quickly pass the point of amusement, however, and get down to business.

## Recording Sound

When you include sound in your materials, one thing that is necessary is to be able to record and edit sounds conveniently. This requires sound editing software such as Macromedia's *SoundEdit.*

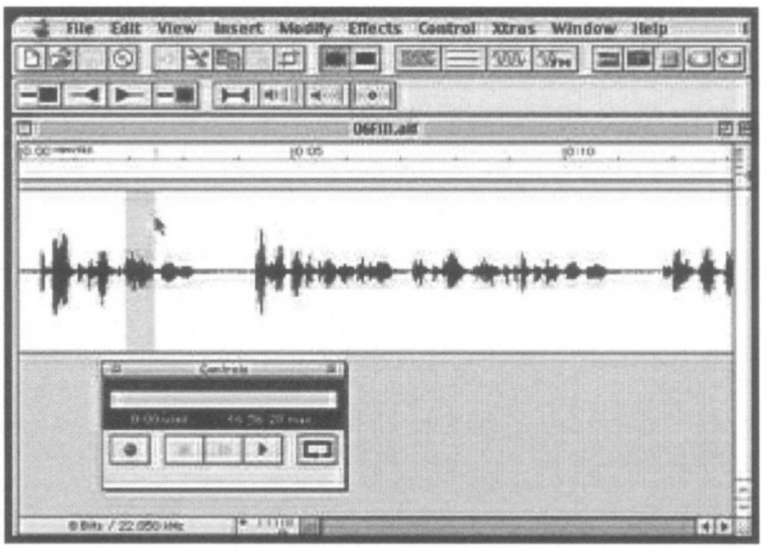


**Figure 8.16. Modified screen capture from Macromedia's *SoundEdit*, an excellent sound editing program.**

## GLOSSARY

bandwidth: in Internet jargon, the amount of electronic information that can be delivered per unit of time.

bundled: a package containing several related products, such as a piece of hardware together with one or several software packages used in conjunction with the hardware. The software packages often are limited editions of very well-known, powerful applications that urge the purchaser to upgrade to the full version, at extra cost.

digital camera: records image as digital information on some digital storage medium (like a memory card).

digital technologies: technologies in which information is dealt with as strings of zeroes and ones rather than as a continuous (analog) signal.

draw; drawing program: graphics program that creates image elements using vectors whose appearance can be modified by selection followed by changing a parameter. [Contrast with paint programs that store information on a pixel-by-pixel (dot-by-dot) basis.]

drive space: the amount of room available on a hard drive. At one time, PCs with 10-megabyte drives were thought to be huge; today 2-gigabyte drives are small.

DVD (Digital Versatile Disk; originally called digital video disc or disk): an evolving format for compressed, digital video.

GIF (Graphics Interchange Format): a pixel-based image format created by CompuServe and used widely on the Web.

interlaced; interlacing: the scheme for sending sliced sections of an image in an alternating fashion to make images viewable more quickly. As more information becomes available to the browser, the interlaced image sharpens.

JPEG (Joint Photographic Experts Group): standard for a lossy compression format used for images and *QuickTime* movies.

MIDI (Musical Instrument Digital Interface): a communications protocol between electronic musical instruments and computers

MNG (Multiple-image Network Graphics): an emerging format to deal with Web-based multimedia.

MPEG: a lossy compression format that is very efficient for movies. Requires hardware (chip) to replay from most desktop computers.

paint; painting program: image strategy involving individual dots or pixels in a screen. Cumbersome to modify after files are created.

Photo CD: digital format developed by Kodak and used to create optical storage media holding very large amounts of visual information.

pixel: dot on a computer screen. There are typically 72 dots per inch on a computer screen.

PNG (Portable Network Graphics): a pixel-based image format.

RAM (Random-Access Memory): Space in computer where programs and data are stored while in use. At one time, 64K was large; this manuscript was produced on a system with 192 megabytes.

sliced; slicing: breaking the image file into several chunks for transmission.

thumbnails: small image representations of larger images intended to facilitate either looking at or managing the larger images. Thumbnails have much smaller file sizes than their corresponding full images, and download relatively quickly in Web pages.

Web page: describes a hypertext file transmitted from server to client using the Web.

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# CHAPTER 9

# Promotion of Self-Regulated Learning

The early literature about students using the Web describes successful students in terms that teachers frequently use to describe students who traditionally succeed. While all teachers enjoy these successful students very much, many students come to us in less than perfect form to succeed at the tasks we ask of them. This chapter is about making students better at academic survival. A goal for us in writing this book has been to direct readers toward what we believe to be the best available literature to assist you when making Web course design choices. Thus far, the literature related to Web-teaching has spoken about the less than perfect students with a single voice – don't admit them. While that strategy nearly always leads to teacher success, it does not address the realities of the students we meet.

In traditional settings, the instructor controls the classroom to some degree. Class attendance may be a requirement. Students in a class can engage in activities; participation can be an integral part of their grades. Over the Web, students have much more freedom than in a classroom. They may be logged into a Web site, but not even in the room. It is not possible for the instructor to tell exactly what students are doing. Students who are poor at self-regulation easily can be "slaughtered" in Web-based courses. On the Web, if your students are not self-regulating, how can you hope for success?

The research literature in the area of self-regulation often is found under the heading metacognition {U09.01}. While literature about Web-teaching is sparse on this issue, there is a rich literature about distance learning. In distance settings, attrition rates (lack of success rates) of 50% are commonplace. But it is not clear that high dropout rates are intrinsic to the distance process. Kevin Cox

{U09.03} suggests that: "If you have a high drop out rate then all other things being equal you probably have a poor course."

A very basic question about teaching, especially college teaching, is "can we do much anyway?" Christy Horn's work (studies of introductory biology classes [Horn et al., 1993; Horn, 1993, 1995]) determined that the biggest fraction of lack of success can be attributed to students' not trying! Worse yet, this problem is not localized; it is widespread at major universities. Students who do not attend classes, do not interact with the learning materials, and, therefore, have very low success rates. Horn's work is representative of many that document the breadth of a troubling situation. Instructors can do only so much to improve their teaching before the lack of student involvement becomes a limiting factor.

There is substantial hope that successful interventions are possible, however. As one of several responses to Horn's results, faculty have developed Web pages for student use. For example, William Glider [1996] has developed Web pages with opportunities for submitting questions, access to tutorials, access to old quizzes with answers and discussion, and enrichment materials. Questions are entered using standard HTML form elements. Glider has documented improved student learning [Horn et al., 1997]. Recently Shin [1998] suggested guidelines for instructional design that might promote students' self-regulation. Keller [1999], originator of the ARCS (Attention, Relevance, Confidence, and Satisfaction) model of motivational design, suggests ways to use this in computer-based instruction and distance education. Puntambekar & duBoulay [1997] describe a system, Metacognition in Studying from Texts (MIST), that includes three features to foster metacognition. Their system was used more productively by high ability than low ability students, however.

**Self-regulation** concerns the entire range of factors that affect student performance. Intelligence is a controversial construct describing factors about which teacher impact, at best, is limited. Self-regulation is something that is teachable and not especially constrained by intelligence [Symons et al., 1989]. Self-regulation accounts for the ability of persons of modest intelligence to become skilled masters of very complex tasks.

Interventions aimed at improving self-regulation are one way for teachers to impact students' lives. According to Gregg Schraw, teaching self-regulation may be the most important thing a teacher can do for students; it may amount to empowering them to be lifelong learners. This kind of thinking pervades the community of educational psychologists studying these issues:

> A new vision of education is emerging. It is one in which children are provided procedural instruction throughout their academic careers, one in which strategy instruction is at the heart of education. This reflects the belief that a major goal of schooling is to teach people how to read, write, and solve problems.
>
> Symons et al., 1989, p. 1

While there is reason to be very optimistic, there still is every reason to acknowledge that enhanced performance resulting from some training about self-regulation is unlikely to work miracles. Most of what *Web-Teaching* deals with concerns teaching and learning beyond grade 7, with an emphasis on advanced high school, college, graduate education, and industrial training. When good jobs are involved, it is an easy matter to see how to improve self-regulation. Indeed, good suggestions to improve one's performance are likely to be welcomed and embraced quickly. In school, those who are poor self-regulators are unlikely to be quickly changed in spite of the hope that self-regulation can be taught to nearly all learners.

## SELF-REGULATION

Self-regulation is a relatively new construct in research on learning. Self-regulated learners attempt to adjust the characteristics of their behavior, **motivation,** and cognition to fit the task at hand. Perhaps most important, control and goal setting come from within the student; they are not externally imposed.

> Self-regulated learning involves the active, goal-directed, self-control of behavior, motivation and cognition for academic tasks by an individual student.
>
> Pintrich, 1995, p. 5

Interest in enhancing student self-regulation relates to compensatory effects. Given two persons with different skills, one with very high knowledge but low self-regulation, and the other with average knowledge but good self-regulation, the second person is more likely to be successful at a task in a given knowledge area than is the first. Self-regulated learners actively control the learning environment. They schedule appropriate amounts of time, find physical environments appropriate for their effective study, have materials ready, plan human resources as needed (e.g., peer helpers and tutors.) Self-regulated learners work to control their motivation and find ways to deal with anxiety. They opt for study time instead of electronic games. Finally, self-regulated learners choose cognitive strategies that have higher payouts; they seek to understand ideas and material rather than just memorize and recall.

> Motivation is the process whereby goal-directed activity is instigated and sustained.
>
> Pintrich & Schunk, 1996, p. 4

Of course, we'd all like students to be self-regulated learners. Indeed, we ourselves strive to be self-regulated. If you're reading this book, you're almost certainly self-regulated. This book might find its way to being a text in a few graduate courses, but more likely it will be read by teachers seeking to improve their teaching. So, if you're reading this page, you're self-regulating. How do we teach our students to be self-regulating?

> Self-regulated learning is a way of approaching academic tasks that students learn through experience and self-reflection. It is not a characteristic that is genetically based or formed early in life so that students are "stuck" with it for the rest of their lives.
>
> Pintrich, 1995, pp. 4-5

## PRINCIPLES FOR ENCOURAGING SELF-REGULATION

Self-regulation is a new enough construct there has been little research into how to teach it. There still is dispute among experts as to how generalizable self-regulation strategies are, particularly as they pertain to understanding one's own cognition [Borkowski et al., in press].

It shouldn't surprise anyone that tests of strategies for teaching this material using the Web are not available. In fact, there are two extremes of Web instruction. At one end, you'll be using a small portion of course supplementary material on the Web; at the other, nearly the entire course will be Web-delivered. Obviously the ways in which you, the teacher, might go about working to enhance self-regulating skills in students will be a function of the situation in which you operate.

### Focus on Content Mastery

> Rather than assessing what was needed to complete the task assigned to them, mastery oriented individuals apparently approached the task of learning biology as a knowledge construction task which led to increased performance on the classroom performance tasks, as well as the knowledge construction tasks.
>
> Horn, 1993, pp. 52-53

The focus should be on content mastery rather than task mastery. One way to do this is to explicitly link assignments to content mastery, and explicitly point out the relationships.

## Attributional Feedback

Attribution {U09.03} is the perception of causality, or the judgment of why something has occurred [Weiner, 1972]. As it turns out, the allocation of responsibility for why something turned out the way it did materially influences subsequent behavior. Discussions of attribution fall under three rather distinct categories: locus of control (i.e., internal vs. external causes), stability (i.e., short vs. long-standing effects), and controllability (i.e., controllable vs. uncontrollable).

Locus of control deals with issues about whether success is or is not in the realm of an individual's capabilities. None of your authors can play basketball anything like Michael Jordan. All three of us can do calculus problems. Intelligence (IQ) and athletic ability are very real. Learners who have decided that a task is beyond their capability don't try, and don't succeed. The cause of their failure is perceived to be outside their realm of control.

Stability is the part of attribution that permits someone to write off poor performance to a "bad day." In the student's view, intelligence is something that doesn't change. Teachers do. So, if the student attributes lack of success to a teacher, then next time, "I'll do better with a new teacher." In an online course, the student might say, "Next time I'll take this course in a classroom rather than over the Web. I failed because it was taught on the Web." The cause of the failure is not perceived as permanent; the cause of the failure will go away.

Controllability is a third dimension of attribution. While we may have the ability to sink seven of ten foul shots, your authors certainly don't practice in a fashion that would elicit such a performance. A student in a Web course with deadlines might decide that there is not enough time to learn the material, and thus not put forth effort. Controllability is the part of attribution that permits us to think we'll do better if we work harder.

Learners will do better when they believe they are able, that any impediments are temporary, and that effort will pay off [Wood & Locke, 1987; Vrugt et al., 1997]. Unfortunately, students seem to attribute more and more of their failures to external, long-standing, and uncontrollable causes, and less and less to internal, short-term, or controllable causes. As a result, they often simply fail to put forth the necessary effort.

Whenever something new comes along, there is a ready-made excuse that poor performance is due to whatever is new. The Web is new, and may well become such a target.

## Increase Student Awareness of Their Own Self-Regulation

Self-monitoring {U09.04} is the basis for awareness of one's self-regulation. In some ways it is akin to an architect's plans for a house versus what actually is built. It is hard to make self-monitoring happen, especially to

get students to disembed actions or processes from complex contexts, and to relate them to outcomes.

Journaling is one of the most common strategies used by teachers. Journaling has been encouraged at the University of Nebraska–Lincoln for over 20 years. It would be a bad idea to require all students to keep learning journals online, or to have them all shared over the Web. However, you might be able to get some volunteer journals, provide them as examples, and encourage those volunteers to create accompanying analyses.

Another approach you might take is to create sets of materials and offer students different ways of approaching learning those materials. Develop systematic assessments, and try to tie the performance to the approach. For example, one week you might have students log on to the Web daily for 30 minutes, and compare their results with logging on for one 2 to 3 hour session during the next week. When did they achieve better learning? (You could incorporate the same strategy for testing the impact of duration of study into a Weblet on a CD-ROM.)

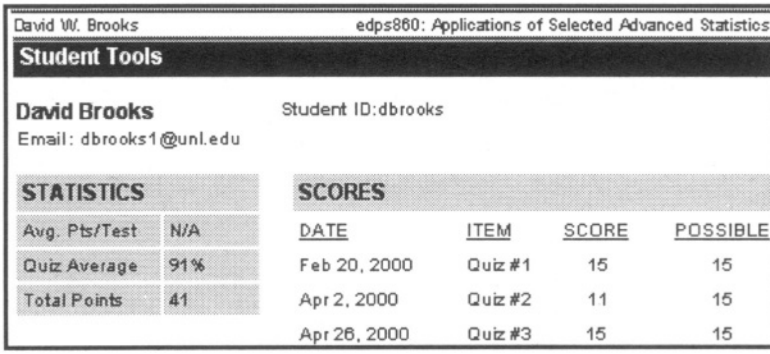
Have students begin some material by going to old exams, as opposed to reading the material first. Do they do better when practice exams precede or follow the exposure to the content?

A narrow focus for self-monitoring gives better results than a broad focus [Shapiro, 1984]. This is a good role for the teacher – to dissect tasks, and focus on their parts. Final assessment in a course may be limited to one grade for each student, or possibly a few paragraphs. There are probably scores of tasks that go into making these assessments. The teacher should focus the students' attention on those tasks that are most productive, cause the most difficulty, or are least appreciated by students, but focus.

Whole-class self-monitoring {U09.05} is a recommended teaching strategy, especially in lower grades. However, applications in higher levels seem reasonable. For example, if participation during asynchronous discussion is required, then having students monitor their own participation makes sense.

One of the hardest things to do with college students is to get them to undertake self-monitoring. In the absence of some serious external intervention, students can muddle along. In fact, even when students can be shown that monitoring improves knowledge of performance, there still can be a problem. Schraw [1994] noted substantial discrepancies between actual performance and knowledge of what works best.

Self-regulation strategies for students should be designed into most Web courses. If you are using a courseware product, for example, there probably are features that provide text and graphical feedback for the student regarding their progress and assessment data for the course (Figure 9.01). Instructing students on the use of these features in the courseware package might also help them monitor their own progress and achievement in the course.


David W. Brooks edps860: Applications of Selected Advanced Statistics

**Student Tools**

**David Brooks** Student ID:dbrooks
Email: dbrooks1@unl.edu

| STATISTICS | |
|---|---|
| Avg. Pts/Test | N/A |
| Quiz Average | 91% |
| Total Points | 41 |

| DATE | ITEM | SCORE | POSSIBLE |
|---|---|---|---|
| Feb 20, 2000 | Quiz #1 | 15 | 15 |
| Apr 2, 2000 | Quiz #2 | 11 | 15 |
| Apr 26, 2000 | Quiz #3 | 15 | 15 |

Figure 9.01. **Modified screen capture of sample student record found in Blackboard courseware.**

## Engender Positive, Realistic Views of Student Self-Efficacy

> Self-regulated learning is generally viewed as a fusion of skill and will.
>
> Garcia, 1995, p. 29

Perceived self-efficacy involves people's judgments about their capabilities for organizing and executing actions to succeed in specific performances [Schunk, 1989]. Self-efficacy beliefs are extremely important [Pajares, 1996]. These beliefs are task and context specific, and cannot necessarily be generalized from self-esteem or self-worth. Horn [1995] presented results in this area that were downright scary. In spite of all sorts of evidence they were doing poorly in a class for which they had not learned the material, many students believed things would work out well for them in the end.

Often, when students believe they have no chance of learning materials because they are not smart enough or haven't had the right opportunities, then a situation dissimilar to the one mentioned above may occur. Students may engage in a self-handicapping strategy. In anticipation of a poor result, they work less. When the bad result arrives, they can say they could have done it, but chose not to do it.

On the other hand, sometimes having low expectations in an area deemed necessary pays off. Some students concerned about poor performance make use of "defensive pessimism" [Norem & Cantor, 1986]. They work very hard to overcome poor performance – studying, putting forth a strong effort. In this way, if they perform poorly they are not so disappointed by the outcome; they did their best. On the other hand, they have used this to muster and apply personal learning resources in ways likely to avoid the poor performance. High

levels of learning are not always driven by high self-efficacy and high competence.

A good result from taking a practice test would be to provide the feedback, "If you perform this way on the course exam, you'll get a C+." That's the kind of feedback you can build into practice tests at your Web site.

The Keller Plan strategy [Keller & Sherman, 1974], in which students are required to reach a certain level before they can go on, deals with this problem. Keller's strategies work very well for courses, but have mainly been abandoned. They create a higher demand on teachers and on students because of the minimum learning standard adopted. In a sense, it requires that all passing students be above average with respect to content learning, and not just some students. If student performances are distinguished from one another in these Keller Plan courses, it is through the time required to reach successful completion; weaker students take longer.

### Model Self-Regulated Learning

Modeling self-regulation can involve talking out loud while working through problems. This often is most effective when the instructor gets stuck, and has to concentrate and "think hard." Some students find this very frustrating, especially students who see teachers as authority figures and sources of knowledge. This just cannot be done on the Web! Unless there is an active cooperative learning community in place and functioning critically, erroneous contributions need to be corrected early.

If confusion and/or misconceptions can be anticipated, the instructional sequence can be designed to attract and capture users, leading them to a Web-based dead end. That is, a path can be created that leads to a conclusion that flies in the face of reality. In science education, experiments with generally unanticipated outcomes, called discrepant events, are used to bring student's beliefs into conflict with their observations. An excellent example of using discrepant event strategies is found in the physics materials of Chapter 11.

### Provide Practice for Self-Regulated Learning Strategies

Have students work with "infinite" exam banks of the type that are readily generated for the Web. Students can see numerous questions, and they can see the related, worked-out examples. The support for using worked-out examples {U09.06} is very strong [Pressley (with McCormick), 1995; Renkl, 1997 {U09.07}].

### Make Your Web Tasks Opportunities for Student Self-Regulation

The most strongly advocated approach to including opportunities for student self-regulation is to give students choices. Experience also suggests that challenging tasks stimulate self-regulation better than do routine or boring tasks. Setting a mastery orientation for the material is good. To whatever degree possible, this can be achieved by tying the learning to future goals in some meaningful way. Teachers often seek to tie everything to a student's future, shying away from content, particularly abstract content, that does not have an obvious relevance. Not everything students learn must be directly relevant to their future.

One view of this centers around a concept called just-in-time learning. In this notion, expert systems (often called electronic performance support systems {U09.08}) are developed to teach persons (workers) what they need to know about something just at the moment they need to know it. That may work for knowing which federal regulations apply in determining benefits for a Medicaid recipient. We don't expect to see just-in-time calculus anytime soon, and we do think knowing calculus has value for all learned persons, not just scientists and engineers.

## EXPLICIT TRAINING

Providing explicit training about strategies, particularly to college students, may be a valuable investment of time. Our work brings us into middle school and high school classrooms in Nebraska on a regular basis. Schools are not always breeding grounds for effective self-regulation. Often, there are low expectations for performance, alternatives for those who do not perform successfully, and a pervasive notion that all the work must be accomplished in the classroom with little or no outside-of-class effort required. An unintended result may be that students do not develop self-regulation.

**Volitional** processes are those "thoughts and/or behaviors that are directed toward maintaining one's intention to attain a specific goal in the face of both internal and external distractions" [Garcia et al., 1998]. Volition is a subset of motivation. Students may have good goals, but sticking to the paths likely to achieve those goals is difficult for many. Correlations between volitional control and strategies were stronger than between strategies, suggesting that strategies are modular and can be acquired somewhat independently of one another. Getting students to continue working towards their goals is a challenge for Web-teachers.

For these reasons, college teachers, especially those in large introductory courses, should consider explicit instruction about self-regulation. For example, it may be well worth your time to point out the need for finding a quiet place to

study, and planning adequate time for study while the student is fresh enough for the study to be effective. Students need to be reminded that daydreaming time must be subtracted from total time to get an idea of how much effort has been expended. In some home environments, a parent externally imposes restrictions about study time and place. These cease to exist when attending a residential college; students simply do not notice their absence.

Students don't believe that distributed time pays off, so they procrastinate. An essay question on descriptive chemistry usually presents difficulty for students taking the AP Chemistry. In 1997, Crippen and colleagues built a Web site that gives students sample quizzes, and offers a wide range of tutoring options [Crippen et al., 2000]. The largest number of hits at the site occur the day before the test. The week of the test sees the largest number of weekly hits. Practice and study would be better distributed than concentrated so near the test.

Schraw advocates explicit how, when, and why instruction in general strategies [Schraw, 1998]. For example, as one of several reading strategies, slow down. How: stop, read, and think about information. When: the material seems especially important. Why: this strategy enhances the focus of your attention.

Another important feature is control of attention. Study is not like a video game where you must attentively track some screen icon or note some event to avoid disaster. Students must self-monitor their attention and do things to control that attention.

Formal instruction about self-regulation is appropriate. In fact, suggestions about controlling motivation are useful. Having a formal reading of *The Little Engine That Could* may well be a valuable college exercise [e.g., as retold by Piper, 1984, 1930]. You also might consider explicit strategies for students related to writing class notes. In a Web-based course, having formal activities in which the students consolidate and organize what they have learned may prove to be very necessary.

## DISCIPLINE-SPECIFIC SELF-REGULATION

### Implicit Conventions

Every profession has rules that are implicit. Sometimes professionals are so far from their roots that they take these rules for granted. For example, in chemistry, when a balanced chemical equation does not have a numerical coefficient written in front of each formula, then those numbers are assumed to be ones (unity). A beginning chemistry student may not understand.

An important task of the instructor is to try to make explicit as much of the "implicit stuff as possible. A very good way to do this in a live, face-to-face classroom is to have the instructor tackle a problem that is ill-defined. When

doing the problem, the instructor should try to "talk out loud," step by step, as the problem is worked. Gilbert Stork {U09.09}, a world-renowned synthetic organic chemist, uses this technique as well as any teacher. In Stork's teaching, there is one after another verbalized rhetorical question followed by his discussion of the answer. Students listen as he speaks out loud to himself. It is not at all interactive, but it is wonderful. For this strategy to work, the problem can't be too simple or routine. At the same time, it can't be too complex. In mathematics or physics, for example, doing a routine end-of-chapter problem is likely to be so automatic for the instructor that the implicit steps are chunked and handled so quickly that they are not revealed during a discussion of the problem. We have not yet seen good ways to handle this kind of instruction over the Web.

### Overarching Notions and Ways of Thinking

There are three ways to view chemistry. There is a macroscopic view – what the eye normally sees. There is a submicroscopic view – the atomic and molecular level models that chemists invoke to explain the macroscopic phenomena. Finally, there is a symbolic view – a way of using elemental symbols, chemical formulas, and other symbol systems to represent chemical changes [Greenbowe, 1983; Herron, 1996]. It is worthwhile for chemistry teachers to make these ways of thinking explicit. Every profession has its models and icons and symbols and ways of viewing the world. Making these explicit to novice learners is a key task in instruction.

### Experts versus Novices

Much research is being expended to compare the ways experts and novices tackle problems in disciplines. One mission teachers can undertake is not only to try to make explicit the ways in which they undertake problems, but also to try to indicate difficulties with the ways novices often undertake the same problems. For example, while experts in physics are making sketches about a problem, novices are likely to be plugging available numbers into some formula. Experts begin by using proven problem solving strategies.

## EXAMS

Using the Web, there may be a temptation to make exams easier than you would otherwise. In particular, there may be a trap related to rewarding memorization and rote. This is a serious potential pitfall, one that works against engendering effective self-regulation in students. Remember, when all else fails, have learners write essays that are e-mailed to you. If there is a standard course

word processor *(Word, AppleWorks),* then you can have elaborate documents with embedded figures and spreadsheets, attached to their e-mail.

A strategy used with great success is called repeatable testing [Moore et al., 1977]. Students are given the option of repeating every test and earning a score equal to the average of their two tests. In the end, the best results may come from demanding minimum standards for parts of a course, and sticking to those standards come hell or high water.

## VIDEOCONFERENCING

Web-based videoconferencing (see Chapter 5) is one way to work with individual students and small groups of students in the areas of self-regulation. This electronic face-to-face opportunity, coupled with an electronic whiteboard, may be the best way for you to capture for the Web what you now have in person.

## GLOSSARY

motivation: the process whereby goal-directed activity is instigated and sustained.

self-regulated learning (self-regulation): the active, goal-directed, self-control of behavior, motivation and cognition for academic tasks by an individual student.

volition: volitional processes are included within self-regulation, and deal with an individual's ability to assume responsibility, to perform duties conscientiously, and to predict success. Volition helps learners control cognition and motivation. Volition is thought to be trainable.

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# CHAPTER 10

# Creating and Managing Web Sites

If you have Web access, you probably have the potential to create and maintain a Web site at your office. Modern computers often come bundled with software capable of converting them into desktop servers. This chapter introduces issues related to managing a Web site.

If you are a teacher, your school probably already has one or more Web sites. The server for this book's Web site is hardwired to the University of Nebraska–Lincoln's network; there is no modem. Most University of Nebraska–Lincoln (UNL) rooms are outfitted with one or more outlets having two computer ports and one phone port. These are centrally controlled; the central office must be contacted to have a particular port activated. Once a port is live, a department or some agency is billed monthly for that port.

If your school does not run a server, use of a server may be available through your Internet service provider (ISP). Server memory of 10-20 Megabytes often is included as part of an ISP's package.

Macintosh computers make excellent servers. Macintosh computers with installed *WebSTAR* software make setting up a server simple. The most difficult part of setting up a server involves waiting for the arrival of the computer.

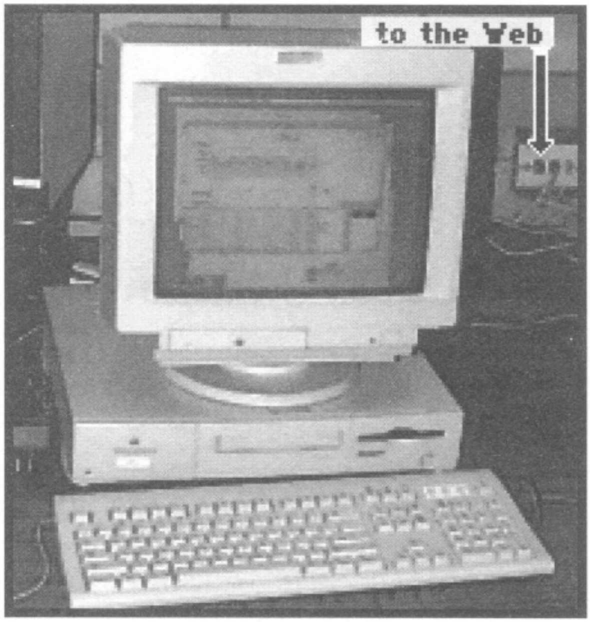



Figure 10.01. **The first full-time server in our laboratory. This trustworthy computer went down only about 5 times during a three-year period.**

As of this writing, the authors run several servers. One is a Macintosh G3 with *WebSTAR* 4 software. After a rocky start due to flawed hardware, that server has done remarkably well. Another is an iMac server with *FileMaker Pro* database software. A third system is used as an experimental server, and still another as a development server. The hardware requirements for successful serving are minimal. Within limits, virtually any recently manufactured computer can be set up as a server.

Servers are usually up and running 24 hours a day, seven days a week. Reliability is critical. (As part of UNL's Y2K precautions, servers were shut down for a couple of days around December 31, 1999.)

You need minimal hardware and software to serve on the Web. But if you are using a telephone modem for Web access, you probably won't want to become a server site. It is very difficult to keep a site up and running all the time on a telephone modem. As of this writing, you really need a dedicated line to serve effectively.

## DOMAIN NAMES/IP ADDRESSES

Your school or organization also has a scarce commodity to distribute, namely, **IP addresses** (Internet Protocol addresses). An IP address is a set of four “8-bit” numbers. UNL owns all of the IP address numbers that start with 129.93.

Whenever a computer is turned on at UNL, the network and that computer exchange information with one another. When a computer logs onto the network, the IP number can be dynamically assigned. A dynamically assigned number is assigned temporarily to that machine, and can be used by different machines at different times. In order to establish a Web presence, the server requires an IP number that does not change. Web servers require a static IP address to allow users consistent access.

The numbers in an IP address, however, lack the elegance and/or memorability found in a name. As a result, IP addresses are paired with **domain names**. All or nearly all US universities have addresses ending in “.edu” (dot-ee-dee-you). The first two numbers at UNL (129.93) translate to “unl.edu.” The domain name of UNL is unl.edu. Similarly, the domain name of Apple Computing is apple.com, and that of the United States National Science Foundation is nsf.gov. Domain names are chosen for their recognizability; it often is easy to guess the name.

When we first set up our Web server, and since we work at the Center for Curriculum and Instruction, we negotiated with the person at UNL who assigns names for the name, “www.cci.unl.edu.” So, on the Web, the numerical IP address and “www.cci.unl.edu” meant the same thing. The www.cci piece was a server name which, when attached to the domain name, identified the particular server with the domain. We’ve had so much Web activity that we changed our domain name to “dwb.unl.edu,” reflecting the senior author’s initials.

If it has not yet been taken, you can buy your own domain name. Some enterprising folks saw the value of some generic domain names and were clever enough to latch onto descriptive names early in the name distribution game, such as wine.com or video.com. They bought these names and have been selling them for significant profit, a practice since controlled by law. Policies for domain names are handled by the U.S. Department of Commerce through InterNic {U10.01}. They approve registrars {U10.02} such as Register.com {10.03} or Domain Factory {10.04}. These registrars will test names for you and, if one is available, offer to buy the name for you for a modest fee. As of February 2000, dwbrooks.org, smgallagher.org, and dnolan.org all were available domain names.

When a name is used, it must go to a “name server” on the Internet that translates the name into a number. The numbers are very difficult for humans to remember, so the name server tells Internet routers what number the domain name indicates. The Internet uses the numbers, not the names.

Having a “neat” domain address might help your teaching, but it’s not required. Once you have a valid address, hardware, a connection to the Internet, and server software, you’re ready to serve.

## HARDWARE – ACCESS SPEED

Nearly any Macintosh computer can be a server. Used computer systems that have a street value under $1000 work well. We have colleagues using old hardware to serve small numbers of students. For example, a Mac IIci or IIcx equipped with an inexpensive ethernet board will satisfy most small server needs very well.

The speed with which information moves over the network determines how fast most documents can be served from a server, not some internal limit. On one of our server’s, HyperCard-based software processes complex requests for tests and enrollments. The requests are processed in 2 to 4 seconds. That time could be reduced by using much more expensive hardware and software, but turnaround time has not been a problem. While some readers of this book might be from large companies with massive Web presences, most readers will be teachers for whom 1000 students would be an enormous, nearly incomprehensible number. For our typical reader, hardware is not a limitation. One of us once ran a workshop from a distant site making connections back to Nebraska. Files were served in seconds. Busy signals were sent when all 18 student stations at the distant site called for the files within the same few moments. By immediately repeating their requests, the server never gave a busy response two times in a row to the same station at the distant site. Expressed in simple terms, we use slow software on modest hardware, but we’ve never had a serving problem, even when we have pushed our system.

Persons with servers receiving many “hits” per day usually choose more powerful hardware. Sun Microsystems {U10.04} provides many such systems. Servers often are **UNIX**-based. **LINUX** servers also are becoming exceedingly popular, and nearly every computer platform has both LINUX operating software and corresponding Web serving software available. Most faculty at UNL use a UNL server; they do not have “private” servers on the UNL network.

When serving files on the Web, line speed usually is the weak link. At UNL, things really slow down around 3 o’clock when all of the students and faculty seem to hop onto the Internet at the same time.

> Despite the increasing number of Web (i.e., HTTP) servers in use each day, little is definitively known about their performance characteristics. We present a simple, high-level, open queuing network model from which we derive several general performance results for Web servers on the Internet. Multiple-server systems are also analyzed. A theoretical upper bound on the serving capacity of Web servers is defined. As Web servers approach this

> boundary response times increase suddenly toward infinity, disabling the server; but limiting the server's simultaneous connections prevents this problem.
>
> Slothouber {U10.06}

## SOFTWARE

*MacHTTP*, application software used by Macintoshes to be able to act as Web servers, was developed by Chuck Shotton. His program has evolved into *WebSTAR* {U10.06}. *WebSTAR* is extremely easy to use. After a simple installation, one merely double-clicks the software's icon. All files at the level of the *WebSTAR* software, or in folders lower in the hierarchy, can be served. This includes html, .gif and .jpg, .hqx, .mov, and other files. From beginning the installation process to actually running your server takes less than 5 minutes.

Entering http://dwb.unl.edu at a browser will bring up the Web page of one of the authors (Figure 10.02).

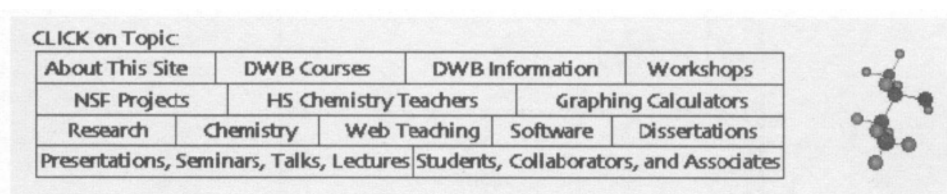



**Figure 10.02. Home page screen for the senior author.**

How did this happen? Your browser sent out a request for a hypertext transfer (the http part of the URL). This request was directed to the server (129.93.84.115, also known as dwb.unl.edu). Over the Internet, routers (the devices that really make this entire engineering marvel work) ultimately direct your message to the server. When the request reaches the server, it is directed to the *WebSTAR* software. Seeing no specific file requested, *WebSTAR* routes this to its default file. In response, the default file is sent out, using the http protocol.

If your server is centralized at some university or school, you will be downloading files, changing files, and so forth. Get help from local experts to learn to do this on your own. You are likely to need permissions and passwords, and these may not readily be forthcoming.

We neither advocate nor discourage setting up a personal server. But setting up and running your own device is no big deal. Complexity of operation is not the issue. It's more a matter of costs, maintenance, and security. It may be much

easier to have someone else running your server for you, and to forego that responsibility.

## SITE ORGANIZATION

The issue of site organization is intertwined with the issue of security. Security is discussed in Chapter 18. When you organize a site, you are really talking about how folders and files are arranged. Figure 10.03 shows partially how the files are arranged on the server site for this book.

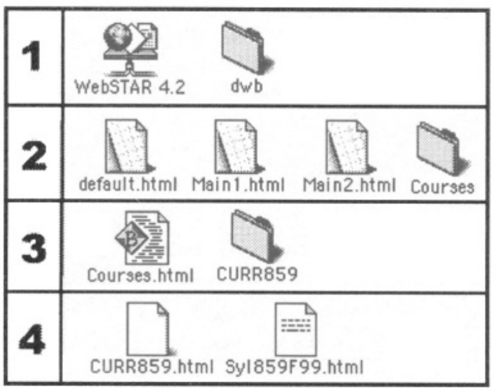



Figure 10.03. **Schematic of a portion of the layout of the server for *Web-Teaching*.**

When one uses the URL http://dwb.unl.edu, the file that is served is named default.html. So, at this site, the default.html file is very specific. It actually passes the call for a file to another file, also named default.html, that is in the "dwb" folder. The second default file sets up two frames, and causes two files to be loaded.

The file residing in the top frame (see Figure 10.02) brings up a clickable image that serves as a topic selector or navigation system. The bottom frame contains more detailed information. The principal task of the first page is to help you find what you want at the site. This page is changed very frequently to reflect changes in material available at the site.

Several strategies are employed to manage the site. Some files change more frequently than others. Files connected to courses or papers presented are changed often, while student biosketches change infrequently. Once a dissertation is cleaned up and posted, it does not change. Very large projects come along, such as this book, or the courses being developed for chemistry

teachers under National Science Foundation support. The folders at the top level of the site help organize these materials and have names like Book, dwb, and Teacher. (Figure 10.03 shows only the dwb folder.)

In the dwb folder there is a folder named Courses. At one time the name default.html was used for the principal or main file in every folder file. This made typing of URLs easier for our users, but it was much too confusing for site management. Now, after the main level of the site, a file with the same name as the folder followed by the MIME extension .html is in every folder. For a list of courses, the URL is http://dwb.unl.edu/Courses/Courses.html.

The file Courses.html points to the various courses for which information is available. One of the courses is Curriculum and Instruction 960, a course dealing with the subject matter of this book. So, to find out about that course, the URL is http://dwb.unl.edu/Courses/CURR960/CURR960F00.html during the Fall 2000 semester. This file is a dynamic course syllabus; it is changed throughout the semester.

When there are many image files to serve, they may all be put in a folder with a name ending in GIFs (e.g., Abstract_GIFs) to keep the site uncluttered. This happens most often when there are instruction manuals about using software. Some of these sets of instructions include nearly 100 image files.

## DETAILS ABOUT SERVING

Every ethernet device has a unique number assigned to it at the time of manufacture. Software is available to poll the computer to ascertain its ethernet number or address. Ethernet addresses are made up of six 8-bit numbers expressed as hexadecimal numbers, such as 08:00:07:6F:5E:32. That number was assigned by the manufacturer to our older Macintosh 6150 server.

Schools and companies usually use a strategy called dynamic addressing. Whenever a computer is turned on, the network and that computer exchange information with one another. The computer tells the network its ethernet number, and the network system assigns it an IP address. Usually the network looks up the ethernet address, and assigns an IP address to the computer that is the same for all sessions. If your ISP provider connects you by modem, however, then you probably have a different IP address for each session that you log onto the Internet.

Server's IP addresses may be assigned manually. A known IP address may be typed into the appropriate fields in the server software to force the computer to have that address. In principle, the system that assigns addresses dynamically should always assign a server the same address. In practice, it is a good idea not to leave this important step to chance.

An alias of the *WebSTAR* software is located in the "Start Up" folder of our UNL server. That way, when there is a momentary power outage that cuts off

the current to the computer, the server usually restarts itself once the power comes back on. The server should be accessed daily and, if something is not right, it should be reset.

Managing files on drives always is challenging. You've almost certainly edited a file, and then thrown it away in favor of an older, pre-edited version. This problem becomes even more serious when you serve software, and people start finding bugs in your material. Both the original and the appropriately packaged derivatives of any materials we serve out to students for our course are maintained on the server. (There is a temptation to keep just the package served, usually a compressed folder, on the server drive without keeping current copies of the files to be served.) In our case, for example, a package of programs about images is served. These are bundled into a folder, compacted and converted into BinHex 4.0 format. Windows users often "zip" their files.

The organization of cgi files can become very confusing. When *HyperCard* is used as the main cgi engine, a folder can be created which contains the *HyperCard* program, its required "Home stack," and numerous other *HyperCard* files (called stacks). The *HyperCard* files can be kept together with other contextually related materials, and "aliases" for those files may be placed in that folder.

There are a few tricks or special situations. The MIME system (the system of file extensions described in Chapter 6) is the basis of software knowing the details of what to do with files. Immediately before a server sends a file, it sends information about the file's MIME type. Server software is likely to be sold with the information needed to handle typical files. For certain file types, especially those using specialized plug-ins, the server software must be provided with appropriate MIME information. We had great difficulty in serving the *Chime* files described in Chapter 8 until we provided the server software with MIME-type information for those files. Anecdotes like this one should add to your concerns about whether or not you ought to become directly responsible for serving files.

### Crashes and Service Interruptions

In Nebraska, violent thunderstorms are commonplace. They often lead to power outages, albeit brief ones, that cause servers to go down. Our server software is set to restart automatically, so when the computer restarts, the server software restarts.

Power outages and surges are an important issue. It is something you need to think about in advance of the event. As often as you've probably heard this in your lifetime about computers, it applies equally well for your server: back up, back up, back up, and then back up again. With servers, this includes having copies of all files either on another computer or on removable forms of data such as disks.

A related issue, perhaps less common, is equipment. During five years of continuous running, we have had one shutdown due to equipment failure. A fan on the power supply of an otherwise faultless piece of hardware failed, and we were "down" for about a day.

A more vexing problem can occur when upgrading hardware. When several changes occur simultaneously, the root cause of the problem may be difficult to trace. Having once changed many things at the same time, after six months of struggles and up to ten restarts a day, a hardware problem finally was isolated. When the faulty hardware was replaced, there was an instantaneous improvement in stability.

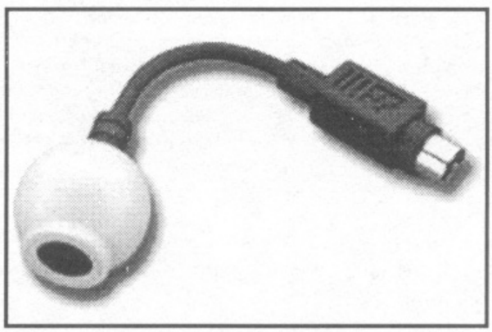


**Figure 10.04. Rebound! {U10.08} hardware. The device plugs into a keyboard or other ADB port. "To detect system crashes, the Rebound! software periodically sets (or "tickles") an internal system timer in the Rebound! hardware. This timer then counts down until the next time the software resets it. While the system is running normally, this communication occurs continuously, and the timer will never reach zero." If and when the timer does reach zero, it performs what amounts to a keyboard restart of the system. A USB product, Kick-off!, was released at press time.**

Software and hardware devices have been developed to deal with software problems. We recommend a product such as Rebound!

The new millennium has brought with it a new service occupation. Companies now exist whose business is to provide secure off-site servers. These are highly secure buildings housing servers; their main job is to restart the server in case of some catastrophic event. Employees are highly trained and are able to spot and correct situations that lead to failures. Three large Web serving service companies are Exodus {U10.08}, Hurricane Electric {U10.09} and AboveNet {U10.10}. These companies usually **mirror** to branches in different locations around the country, so problems in one geographic area do not bring about service interruptions. At the present time, the services are beyond the financial means of most academic organizations.

A final word of caution. If you run your own server, then you must pay attention to security issues. Security issues are discussed in Chapter 18.

## Monitoring Service

Just as Web hosting has become a new industry in the Internet age, so has Web monitoring. Companies like Global NetWatch {U10.12} use software on Internet lines from main providers (AT&T, Sprint, etc.) to access periodically selected Web pages for their clients. They report on Web service regularly, and have the ability to page or phone automatically when serious service interruptions are noted. In addition, they often can help pinpoint the nature of a problem.

> Global NetWatch (GNW) uses its Internet wide network of intelligent remote agents to test, measure, and report to you in real time how your valued customers are experiencing the performance and availability of your Web site. GNW builds invaluable long term performance trends in our central database, immediately alerts you of performance degradation, pinpoints problem areas, and provides the diagnostic tools you will need to return your site to optimum performance levels.
>
> {U10.12}

Global NetWatch provides e-mail reports daily about your service with fairly detailed information.

```
NetWatch Monitoring System Daily Statistics For 2000/03/14.

To review a graphical illustration of your web sites performance over the
past 7 days please proceed to
http://www.globalnetwatch.com/members/index.html,
enter your userid and password, and select "Graphical".

Number of Web Sites (1)
Report for 2000/03/14.

WebSite: http://dwb.unl.edu/teacher/nsf/c03/c03/.html
 Web Checks: 288
 Web Failures: 0
 Good Checks: 100.00%
 Number of Error Notifications: 0
 Downtime: 0 min.
 Average Ret. Time:  0.27 sec.
 Status: Active
```

**Figure 10.05. Sample daily report from Global NetWatch.**

## Server Logs

Server software usually maintains logs rich with information. These logs help you assess how actively your site is being used by your students. The logs also provide telltale information if someone tries to tamper with your site. Several providers offer software packages that help you store and analyze information about site use.

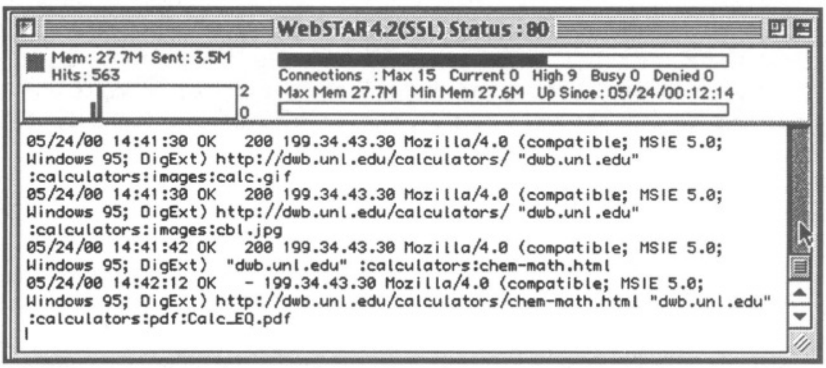



Figure 10.06. Sample server log information from WebSTAR server.

## GLOSSARY

domain name: easy-to-remember address used for identifying and locating computers on the Internet. These are translated by the Domain Name System (DNS) into the numeric IP addresses used by the network. Domain names must be unique.

IP address: a unique, numeric identifier used to specify hosts and networks expressed as four numbers between 0 and 255, separated by periods, for example: 129.93.84.115. These are handled through the American Registry for Internet Numbers {U10.12}.

LINUX (pronounced LIH-nuhks with a short “i”): a UNIX-like operating system that was designed to provide personal computer users a free or very low-cost operating system comparable to traditional and usually more expensive UNIX systems. Linux has a reputation as a very efficient and fast-performing system. Linux’s kernel (the central part of the operating system) was developed by Linus Torvalds at the University of Helsinki in Finland.

mirror: the use of multiple sites with duplicate information. Used to provide instantaneous backup for servers or alternate locations for downloading files.

TCP/IP (Transmission Control Protocol/Internet Protocol): the communication protocol of the Internet. TCP assembles a file into smaller packets that are transmitted over the Internet and received by a similar program that reassembles the packets into the original message. The IP handles the address part of each packet so that it gets to the right destination. Each network computer checks this address to see where to forward the message. In principle, packets may arrive via different routes. A client requests and is provided a service (such as sending a Web page) by a server. TCP/IP is from one point in the network to another. Each client request is considered to be a new request, one unrelated to any previous request. The "connection" is maintained only until all transmitted packets have been received.

UNIX: For all computers there is some core software that runs underneath everything else called the operating system. UNIX is a computer operating system designed to be used by many people at the same time (it is multi-user) and has TCP/IP built-in. It is a very common operating system, and the majority of Internet servers use this system.

**URLs**

U10.01. Internic, http://www.internic.net/ (accessed 4/5/00).
U10.02. The Accredited Registrar Directory: Alphabetical Listing of Registrars by Company/Organization Name, http://www.internicnet/alpha.html (accessed 4/5/00).
U10.03. Register.com, http://www.register.com/ (accessed 4/5/00).
U10.04. Domain Factory, http://www.domainfactory.com/ (accessed 4/5/00).
U10.05. Sun Microsystems, http://www.sun.com/ (accessed 5/24/00).
U10.06. A Model of Web Server Performance, http://www.starnine.com/webstar/summary.html (accessed 4/5/00).
U10.07. WebSTAR, http://www.starnine.com/webstar/webstar.html (accessed 4/5/00).
U10.08. Rebound! http://www.sophisticated.com/products/rebound/rebound.html (accessed 7/23/00).
U10.09. Internet Data Centers, http://www.exodus.com/idcs/ (accessed 4/5/00).
U10.10. Hurricane Electric Internet Services, Dedicated Servers, http://www.he.com/dedicated.html (accessed 4/5/00).

U10.11. AboveNet Web Hosters, http://www.abovenet.com/web_host.html (accessed 4/5/00).
U10.12. Global NetWatch: The Internet Reliability Company, http://www.globalnetwatch.com/ (accessed 4/5/00).
U10.13. American Registry for Internet Numbers, http://www.arin.net/ (accessed 4/5/00).

# CHAPTER 11

# Course Supplements

Organizing and teaching courses that are entirely Web-based is a daunting project. It may involve substantial changes in teaching behavior and definitely increases time spent in planning (especially during the initial set-up.) Although successful discussions on the Web are reported widely by teachers, many discussion questions that spark active, fruitful debate in an ordinary classroom fizzle on the Web. Many teachers restrict their use of the Web to what we call course supplements. Course supplements can be as simple as handouts available on the Web, or as complex as creative, interactive Java applets designed to convey complicated ideas. A dynamic, adaptable syllabus is a very common use. But where the Web excels over traditional teaching methods is in its ability provide complex interactive learning experiences like Java applets to help students understand complicated subjects. The course supplement is probably the most widespread use of Web-teaching.

The Web is a remarkable, evolving communication tool. It allows dynamic, interactive communications. Even teachers who handle all the teaching offline have adopted Web software packages to manage many of the traditional aspects of their teaching: syllabi, handouts, messaging, and even gradebooks (see Chapter 3.)

Research on the use of supplements is emerging. Poë [1999] reports a positive relationship between use of supplements and success in an introductory chemistry course. Donovan & Nakleh [2000] report gender differences favoring women with respect to the use of course supplements in a chemistry course.

For most of us, there has been a topic or issue that we've struggled to teach, but were never quite satisfied with our success. For these situations, the Web has proven to be a remarkable resource. This is especially true when multimedia materials are involved because the Web is a very powerful delivery system.

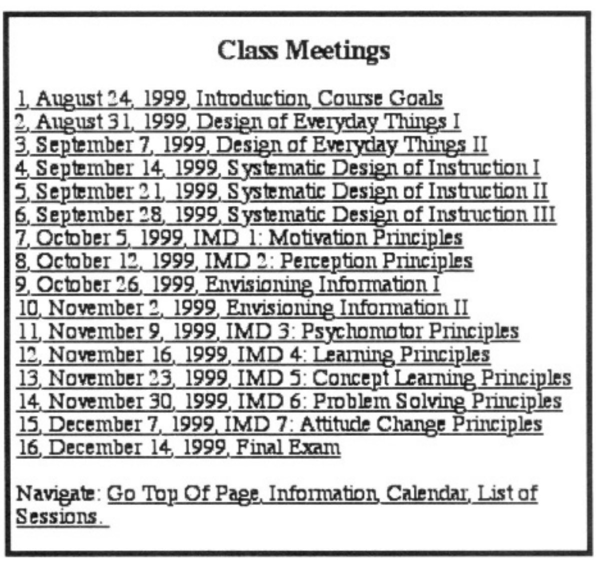
In addition to the many supplements being created by teachers for their own sites, there are numerous supplements being developed by commercial sources. Publishers provide sites intended to be used in conjunction with particular texts. Software developers provide sites to support and extend their product's features.

Perform a Web search before you create new Web materials. With the thousands of free online tutorials and animations that have been created by both educational and commercial entities, what you want may already exist. A quick Internet search for the supplementary material to help your students understand a particular concept may save you hours of work building your own.

## EXAMPLES

### Instructional Message Design

In Instructional Message Design {U11.01}, all of the course management (such as course syllabi, Figure 11.01) is accomplished on the Web. These pages were developed using crude software tools that were available prior to course management software packages.



**Class Meetings**

1, August 24, 1999, Introduction, Course Goals
2, August 31, 1999, Design of Everyday Things I
3, September 7, 1999, Design of Everyday Things II
4, September 14, 1999, Systematic Design of Instruction I
5, September 21, 1999, Systematic Design of Instruction II
6, September 28, 1999, Systematic Design of Instruction III
7, October 5, 1999, IMD 1: Motivation Principles
8, October 12, 1999, IMD 2: Perception Principles
9, October 26, 1999, Envisioning Information I
10, November 2, 1999, Envisioning Information II
11, November 9, 1999, IMD 3: Psychomotor Principles
12, November 16, 1999, IMD 4: Learning Principles
13, November 23, 1999, IMD 5: Concept Learning Principles
14, November 30, 1999, IMD 6: Problem Solving Principles
15, December 7, 1999, IMD 7: Attitude Change Principles
16, December 14, 1999, Final Exam

Navigate: Go Top Of Page, Information, Calendar, List of Sessions.

**Figure 11.01. Portion of a course syllabus used as a course supplement for Instructional Message Design at the University of Nebraska–Lincoln.**

**Amphibian Embryology**

Amphibian Embryology {U11.02} is an example of a very powerful supplementary site developed to support a variety of courses (Figure 11.02). This site is rich with multimedia animations and images, and reflects the kind of instruction not available from a traditional text format. It is especially rich with hypertext links.

The site is typical of the kinds of Web resources that a teacher may find freely available for student use. A quick visit to this site will allow you to ask yourself the question, "How much time would I need to spend to create an equivalent site?" These tutorial pages are connected to Jeff Hardin, a Wisconsin faculty member. They were developed with support from both the National Science Foundation Young Investigator Program and the Lilly Teaching Fellows Program.

Student visitors to such a site, whose interest is stimulated by the materials, will give special consideration to the institution offering the site when making decisions about advanced study in this area. In other words, we suspect that sites of this nature are likely to attract high quality graduate students and research collaborators.

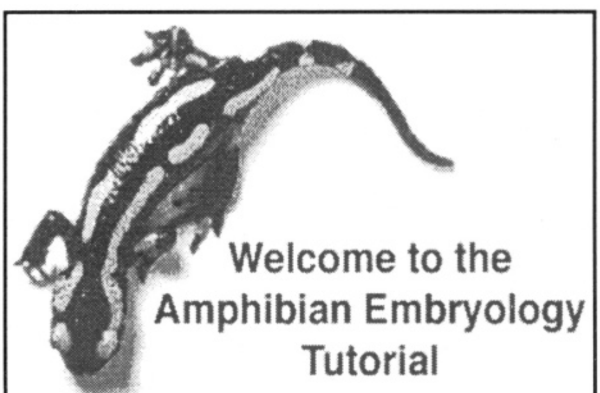



**Figure 11.02. Home page image from the Amphibian Embryology Tutorials developed at the University of Wisconsin.**

## Interior Design

Developing an understanding of construction techniques is important when preparing interior design students. Katherine Ankerson has found the use of multimedia supplements to be especially helpful in her courses related to creating construction documents {U11.03} (Figure 11.03).

While her goals include creating complete courses for a broad audience, the materials that Professor Ankerson has been developing are finding use as supplements with her current students. Faculty designing full courses often report that materials intended for those courses serve extremely well in the interim as supplements in current courses. Approaches to creating Web courses can be made in steps. Because the effort of creating excellent materials is time consuming, a stepwise approach to developing complete Web courses often is the only practical one.

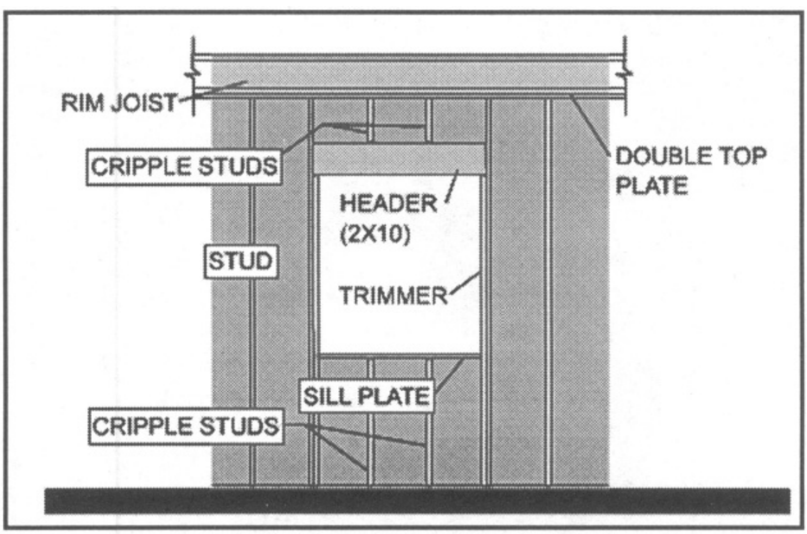



**Figure 11.03. Screen capture from animation illustrating features of wall construction. Developed by Katherine Ankerson at the University of Nebraska–Lincoln.**

## Audiology

Newell Decker has used Blackboard's *CourseInfo* to manage a course, Advanced Practicum in Audiology. He uses online testing to deal with an aspect of testing (Figure 11.04) that once presented substantial difficulty in terms of getting students together with the hardware. This is an example of a situation where efficiencies are likely to be achieved quickly for the teacher. As time goes on, one can envision sophisticated, multimedia-based testing strategies being developed to cover the same material.

Decker reports positive student responses to this strategy for assessing course competency of identification of equipment. This is important, if a Web supplement is to be used effectively, early student acceptance is critical.

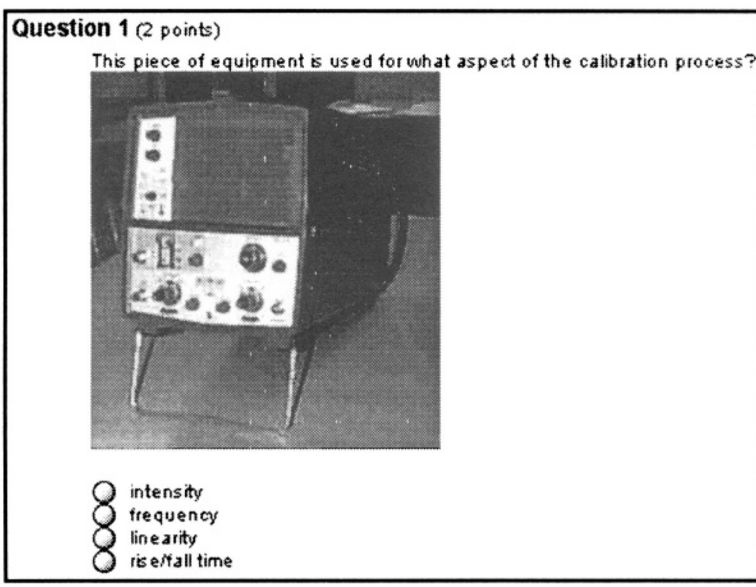



**Figure 11.04. Test item from advanced Practicum in Audiology. Developed by T. Newell Decker at the University of Nebraska–Lincoln.**

## Biochemistry

John Markwell has developed some powerful supplements for use in his undergraduate biochemistry classes. Markwell has developed *ShockWave* animations to illustrate complex phenomenon (Figure 11.05).

Still figures cannot adequately demonstrate the utility of animation for conveying these complex concepts to students. In this case, there is a complex sequence of events that is articulated during the overall process. While the sequence can be expressed in words and enhanced using conventional images and illustrations, the Web animation adds clarity nearly impossible to provide by other means.

This material is available by password access. Some faculty are choosing to permit access to the materials they create for their students only. It is a complex issue that we will revisit in Chapter 19.

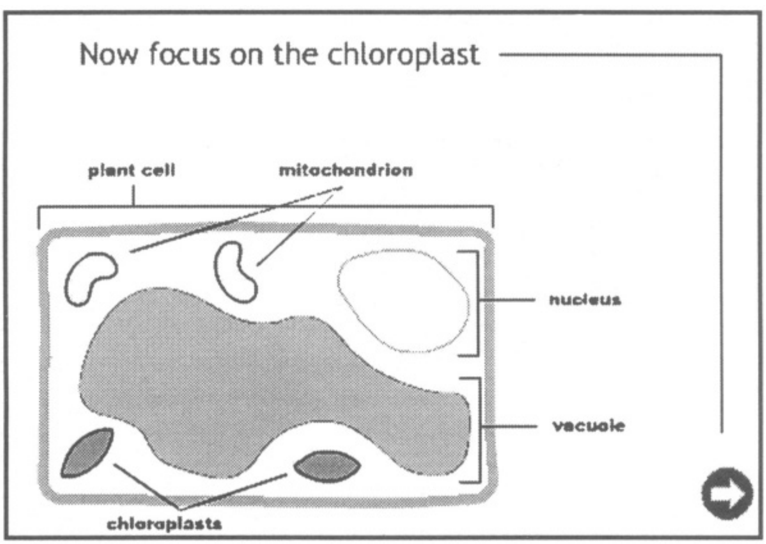
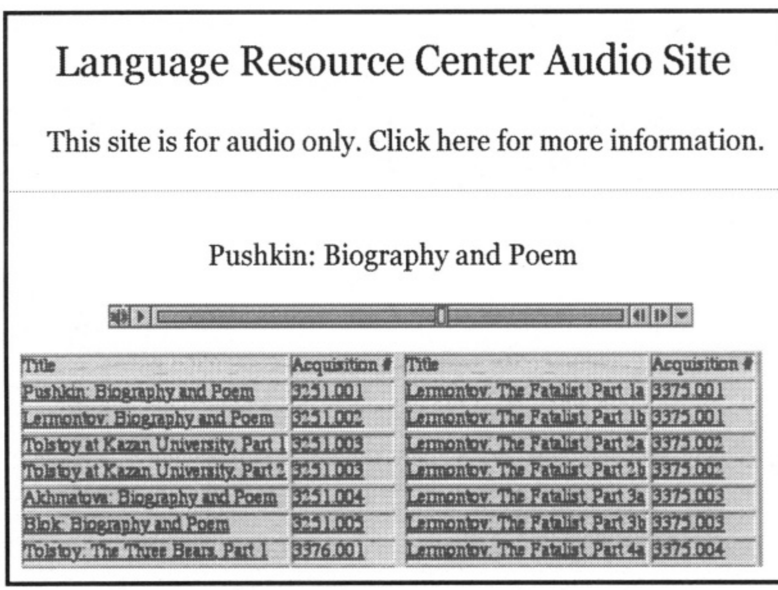



**Figure 11.05. Screen capture from animation describing steps the process of photosynthesis. This elegant animation, executed in Macromedia *Director* and converted to a *ShockWave* file, was created in about 12 hours by John Markwell at the University of Nebraska–Lincoln.**

## Languages

Harvard University has developed a powerful Language Resource Center {U11.04}. Some resources are available only at the Center, while others are available over the Web. Russian audio tapes, for example, ones with very high clarity, are available across campus over the Web (Figure 11.06).

This site illustrates the broad-based nature of the convenience potentially afforded students through Web use. While many campuses have numerous computer laboratories, specialized facilities such as language laboratories tend to be unique and often require that students be physically present at the particular location. Some streamed video materials still require that students visit specific facilities on campus, and much of the material has restricted access. Nevertheless, a visitor to the site can appreciate quickly the opportunities for language training that exist when using Web-based supplements.




| Title | Acquisition # | Title | Acquisition # |
|---|---|---|---|
| Pushkin: Biography and Poem | 3251.001 | Lermontov: The Fatalist Part 1a | 3375.001 |
| Lermontov: Biography and Poem | 3251.002 | Lermontov: The Fatalist Part 1b | 3375.001 |
| Tolstoy at Kazan University, Part 1 | 3251.003 | Lermontov: The Fatalist Part 2a | 3375.002 |
| Tolstoy at Kazan University, Part 2 | 3251.003 | Lermontov: The Fatalist Part 2b | 3375.002 |
| Akhmatova: Biography and Poem | 3251.004 | Lermontov: The Fatalist Part 3a | 3375.003 |
| Blok: Biography and Poem | 3251.005 | Lermontov: The Fatalist Part 3b | 3375.003 |
| Tolstoy: The Three Bears, Part 1 | 3376.001 | Lermontov: The Fatalist Part 4a | 3375.004 |

**Figure 11.06. Modified screen capture of audio tape, "Pushkin: Biography and Poem" made available on the Harvard Campus from the Language Resource Center.**

## Bioscience

William Glider's materials are largely home made. Having started before the development of course management software, the sections shown here, while now available in modern courseware packages, were developed in a pioneering manner. There is no doubt in Glider's mind that his is a traditional course with learning goals similar to those of his many colleagues involved in teaching this multisection college biology course offline.

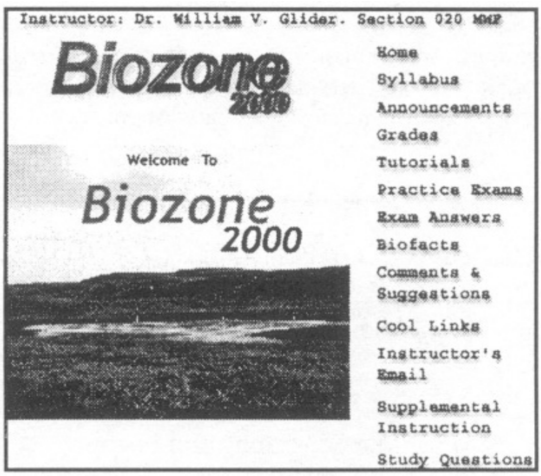



**Figure 11.07. Home page of William Glider's biology class at the University of Nebraska– Lincoln. Access to this page is controlled via ID and password.**

While the topics shown here are found in most Web management software systems, at least three of these qualify as what are best called supplements: tutorials, biofacts, and cool links. (Supplemental instruction, as used in Glider's course, refers to traditional coaching instruction offered conventionally to volunteer students – help sessions, more or less.) An example of a tutorial is shown in Figure 11.08. (These materials are available only to students enrolled in Glider's class.)

Glider exemplifies the work of faculty attempting to improve student learning in large, multi-section, undergraduate science courses. The Web materials have been designed to include tracking student actions. They permit connecting student Web-site work to student performances in the course. We expect important teaching information to emerge from Glider's work.

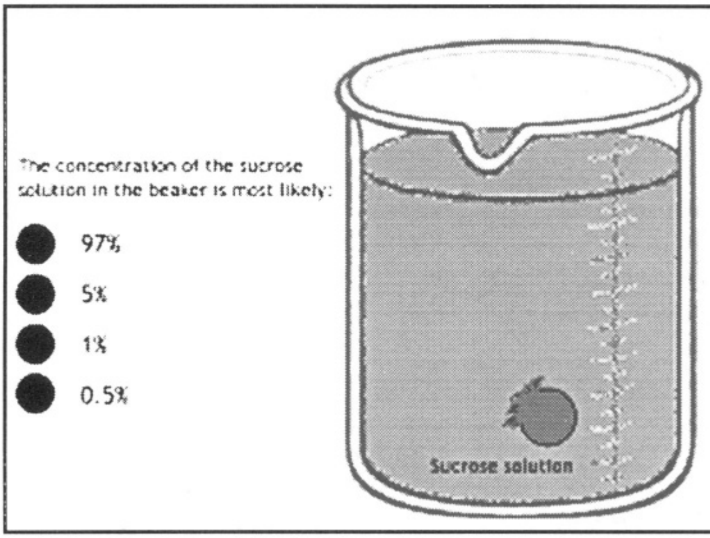



Figure 11.08. **Sample tutorial from bioscience course. Animation (created in *Flash™*) shows red blood cells placed in a solution. Students have four possible responses, and receive feedback.**

## Chem Team

The Chem Team {U11.05} site has been developed by a team of high school chemistry teachers, and is one of several such sites developed at Diamond Bar High School in the Walnut Valley Unified School District, Walnut, California. It is typical for such pages to be linked to other similar resources, such as Audrey Sanderson's chemistry resources {U11.06}.

While the largest amount of effort in educational Web site development seems to be at the college undergraduate level, we find materials that span the preschool to postgraduate levels of education.

## Psychology (Statistics)

As we have noted before, and will note again in later chapters, prior knowledge is the largest single factor that accounts for variance in new learning. Any strategy that can increase current learning is likely to give good results. The optional, open access, repeatable testing used by Calvin Garbin in his statistics courses exemplifies the easy use of this approach on the Web. From virtually any location at any time, Garbin's students can access course materials, attempt quiz items, and receive feedback. Their performance in his courses becomes dependent upon the amount of effort they are willing to put forth.

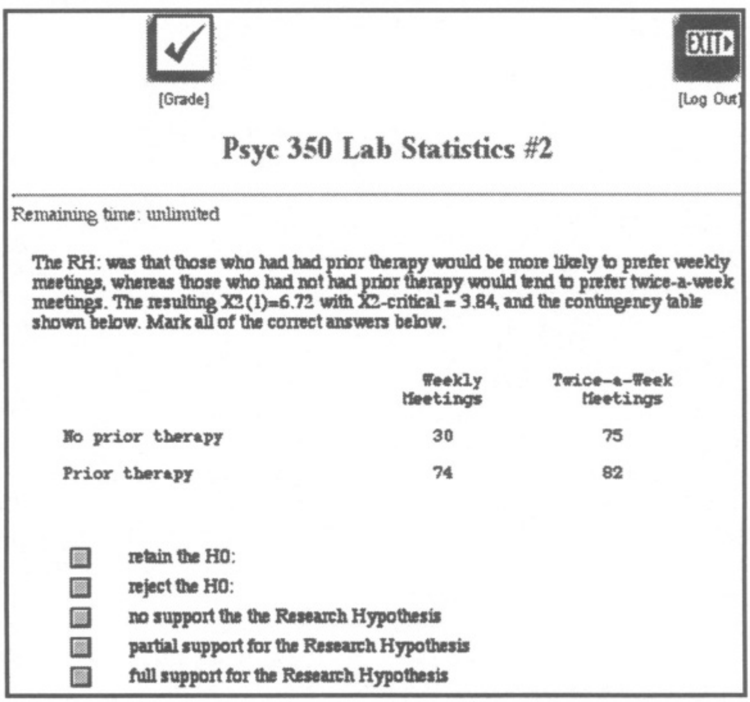



Figure 11.09. **Sample item from Garbin's extensive repeatable quiz bank. Readers can access these quizzes from the UNL Testing Site {U11.07}. For example, choose a Garbin course (such as Psychology 350 Lab), choose an exercise, create a login, and then practice away.**

In Garbin's courses, most of the assignments have a powerpoint or other kind of "reading" available on the Web that the students may read before doing the Web practice. This combination means that folks with different preferred learning strategies can use different approaches. Some students really study for the exercises, and then log in and work all of the problems. Others begin by taking a practice quiz and learn as they go. The exercises are set up on a mastery system. Students aren't done until they get a specified number of practice items correct for each of the topics. Garbin has data showing that the approach used (or one that is intermediate) doesn't influence how much students learn from the exercises.

The RH: was that those who had had prior therapy would be more likely to prefer weekly meetings, whereas those who had not had prior therapy would tend to prefer twice-a-week meetings. The resulting X2(1)=6.72 with X2-critical = 3.84, and the contingency table shown below. Mark all of the correct answers below.

| | Weekly Meetings | Twice-a-Week Meetings |
|---|---|---|
| No prior therapy | 30 | 75 |
| Prior therapy | 74 | 82 |

**Your Answer:** reject the H0:
full support for the Research Hypothesis

**Correct Answer:** reject the H0:
partial support for the Research Hypothesis

Figure 11.10. **Sample feedback to item response from Garbin's extensive repeatable quiz bank.**

### *Mathematica*

Eric Weisstein's World of Mathematics at Wolfram Research, developers of *Mathematica*, provides an extensive mathematics resource (Figure 11.11). With eleven different major subject areas, most with over 200 sub-topics, this site provides a vast quantity of mathematical information.

The link described in Figure 11.11 makes use of interactive figures, something just not possible in texts with conventional illustrations. By accessing this page, placing the cursor on one of the illustrations, pressing and holding the mouse-button down, and moving the mouse, the illustration changes orientation. The surface at the left rotates when the cursor is placed within it. It almost seems as if a three-dimensional surface has been created that the user can manipulate.

This extremely useful instructional material is at a commercial Web site. We suspect that devotees of mathematics using this site often choose to purchase *Mathematica* software and investigate mathematical entities of their own creation.

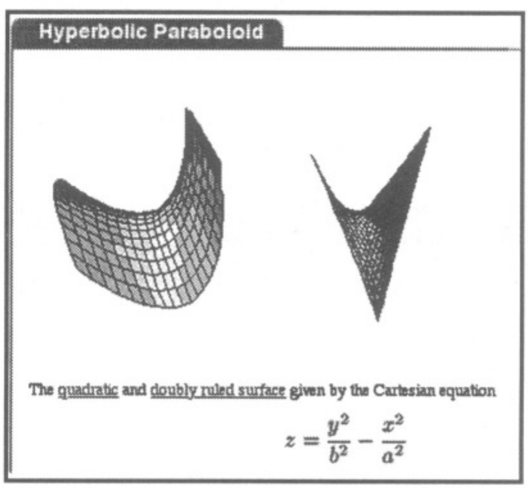



**Figure 11.11. Modified screen capture of one of the sub-topics (hyperbolic paraboloid {U11.08}) in Eric Weisstein's *World of Mathematics*. The two figures shown may be rotated through space to allow the user to view them from any angle.**

## Physiology

Numerous examples are emerging where faculty create course components for Web delivery and use them in place of traditional materials. The physiology laboratory manual {U11.09} by David Woodman is such an example (Figure 11.12).

Laboratory instructional materials tend to be idiosyncratic in that they often reflect architectural features of an institution's teaching facilities, campus scheduling policies, or the local availability of particular resources (especially flora and fauna). The result is that there nearly always is greater diversity in laboratory instruction between similarly-labeled courses on different campuses than there is in related lecture instruction. It is not surprising, therefore, that many laboratory manuals are now found on Web sites. We cannot overemphasize the richness that multimedia affords the teacher using the Web to convey laboratory instructional materials to students. This applies to background information, and to the clear elucidation of those techniques required for successful experimentation.

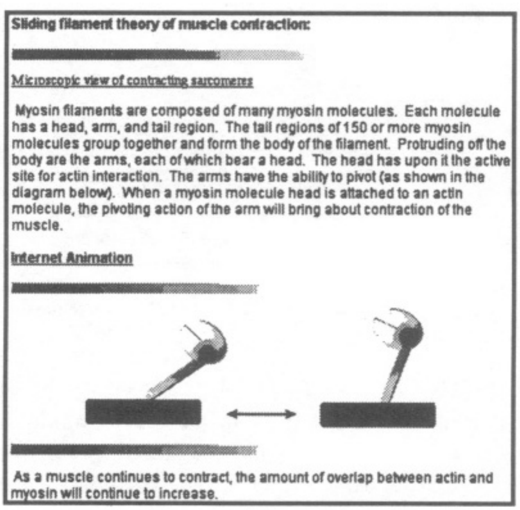



**Figure 11.12. Example material taken from PhysioDisc laboratory manual developed by David Woodman at the University of Nebraska–Lincoln. This screen capture illustrates not only the illustrated notes, but two branches, one to an animation, and the other to a microscopic view.**

## Physics

In teaching, especially in science, there is a strategy known as the discrepant event. One verbally describes a situation, asks students to predict the outcome, demonstrates the phenomenon, and then asks the student to compare the predicted outcome with the observed outcome and rationalize any discrepancy. A really interesting physics demonstration involves rolling two steel balls, one on each of two adjacent tracks as shown in Figure 11.13. The Balls/Tracks {U11.10} Web site, developed by Jose P. Mestra and Tom Koch at the University of Massachusetts Physics Education Research Group (UMPERG) {U11.11}, illustrates this demonstration.

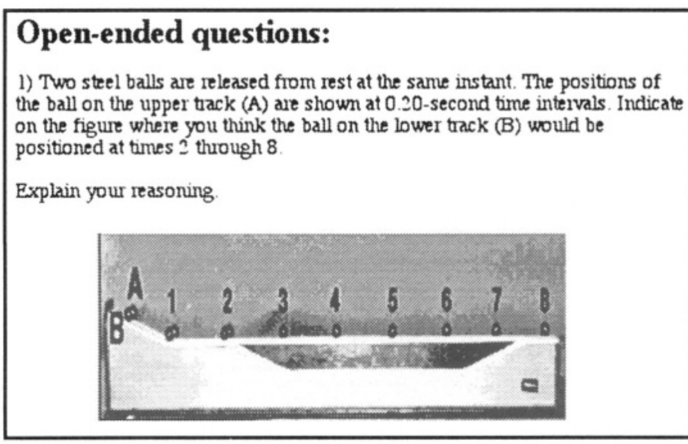



**Figure 11.13. Modified screen capture from the Balls/Tracks site developed by the University of Massachusetts Physics Education Research Group.**

This example illustrates nicely that Web-based materials can achieve open-ended instructional goals. In this situation, there is a single answer. The site developers seek to have students make and explain their predictions.

### Classroom Today

At the elementary school level, several sites offer opportunities for supplements. Classroom Today {U11.12} "provides up-to-date content that naturally links the Internet to the curriculum topics you teach."

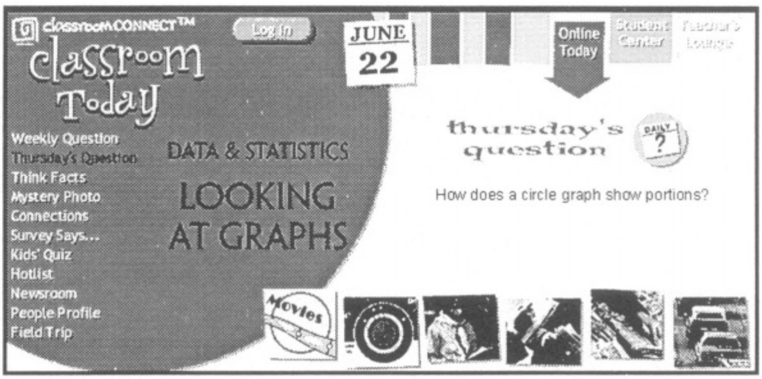



**Figure 11.14. Screen capture from Classroom Today site (June 22, 2000). Reproduced with permission.**

## HOMEWORK

Many high school and college teachers assign homework. *WebAssign* {U11.13} is an example of software that supports homework activities. It delivers the homework, grades responses, provides immediate feedback, and maintains a gradebook.

## REFERENCES

Donovan, W. J. & Nakhleh, M. B. (2000). Investigation of student's use of Web-based materials and understanding of chemistry concepts. Paper 455 presented at 16th Biennial Conference on Chemical Education, Ann Arbor, MI, August 2.

Poë, J. (1999). Virtual office hours. Paper 572 presented at 82nd Canadian Society for Chemistry Conference and Exhibition, Toronto, June 1.

## URLs

U11.01. CURR 859, Fall 99, http://dwb.unl.edu/dwb/Courses/CURR859/Syl859F99.html (accessed 6/17/00).
U11.02. Welcome! (amphibian embryology), http://worms.zoology.wisc.edu/frogs/welcome.html (accessed 5/26/00).
U11.03. Overview of Construction Documents, http://www-class.unl.edu/DDEonline/architecture/index.html (accessed 7/3/00).
U11.04. Harvard Univeristy Language Resource Center, http://lrcnt.fas.harvard.edu/ (accessed 4/4/00).
U11.05. Chem Team: Main Menu, http://dbhs.wvusd.k12.ca.us/ChemTeamIndex.html (accessed 5/26/00).
U11.06. Chemistry resources, http://www.dist214.kl2.il.us/users/asanders/chemhome2.html (accessed 5/26/00).
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U11.08. Hyperbolic Paraboloid, from Eric Weissteins's World of Mathematics, http://mathworld.wolfram.com/HyperbolicParaboloid.html (accessed 6/17/00).
U11.09. PhysioDisc, http://bs-dwoodman4.unl.edu/physio/physiology/muscle.htm (accessed 4/20/00).
U11.10. Balls/Tracks project, http://physics.unl.edu/directory/koch/umass_resch.html (accessed 4/20/00).
U11.11. University of Massachusetts Physics Education Research Group, http://www-perg.phast.umass.edu/default.html (accessed 4/20/00).
U11.12. Classroom Today, http://classroomtoday.classroom.com/home.asp (accessed 6/22/00).
U11.13. Welcome to WebAssign!, http://webassign.net/info/ (accessed 6/22/00).

# CHAPTER 12

# College and K-12 Courses

This chapter attempts to describe just a few examples of online courses that serve different purposes and audiences. Online courses vary widely in their designs. Some courses are conducted totally online without instructor or participants ever meeting. Many courses use a mixed design that affords participants the chance to interact and discuss ideas in a face-to-face, traditional setting as well as the online discussion forums. The design of the course might limit or change the nature of who will be attracted to the course, and the potential number of students who might choose to enroll.

Understanding the type of audience the course is targeting will be a major factor in its design and schedule. In batch mode, all students begin the course at the same time. With a rolling enrollment, the course is more fully automated, and students can begin and end courses on their own time schedule. Stanford Online {U12.01} offers courses, seminars, and professional development topics aimed specifically at engineers and computer scientists. It targets a niche market with its online offerings.

Degree programs are going online. Often online degree programs are offered using a combination of face-to-face and online formats. These mixed-format courses add travel expenses to the cost of taking the course, and may be prohibitively expensive for many students.

Teachers traditionally want to meet their students and have the students get to know each other. A mixed design of face-to-face and Web-based delivery of the content and activities has advantages. Because geography often comes alive during field experiences, an online geography course was taught through the University of Nebraska–Kearney that included a five day field study at the conclusion of the online content. The mixed-design may have limited the

number of participants. The student retention, however, was excellent; every student completed the course during each of the two sessions it was conducted.

Cross campus collaboration is a theme which had begun to emerge at the time the first edition of *Web-Teaching* was published. This theme is found in three of the courses cited in this chapter.

## COURSES

### Chemistry for High School Chemistry Teachers

High school chemistry teachers often do not have much background in chemistry content even though they are certified to teach chemistry. Obtaining a suitable background can be very difficult. Graduate chemistry departments focus their content on those expecting to go into research or industry. Education courses, even science education courses, tend to deal with the teaching process rather than content specifics. With support from the National Science Foundation, a series of 18 1-credit hour courses for chemistry teachers is appearing online. These courses have a public component. Anyone can access nearly all of the materials in these courses, and take the tests. The first course produced concerns water and solutions {U12.02}. Most of the content material was found on the Web; very little was created from scratch. All of the testing is online, with immediate, performance related feedback provided for all except essay items. Questions are in several formats, including multiple choice, short answer, and essay. Multiple choice and short answer questions are graded automatically. Essay items may be submitted for grading by registered students only. All users are provided immediate feedback. Model answers are provided for essay questions. The multiple choice and short answer questions are produced automatically, taking several elements from a database and mixing them up to produce randomly generated questions. Some of the short answer questions require numerical calculations; these questions are created from a database, and hundreds, thousands, and sometimes millions of different versions are available.

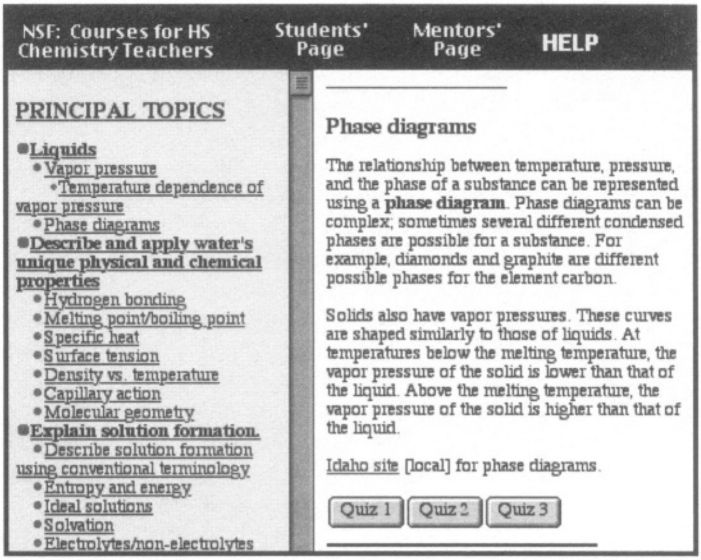


**Figure 12.01.** **Sample screen from chemistry course. The three quiz buttons randomly generate questions on the topic.**

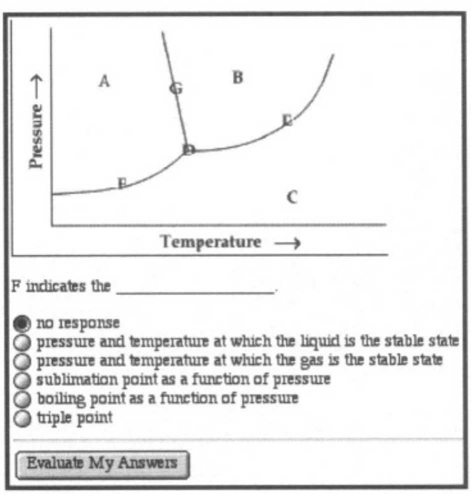


**Figure 12.02.** **One version of Quiz 3, Figure 12.01. There are 6 versions of this quiz question.**

## Statistical Methods

Charles Ansorge at the University of Nebraska–Lincoln teaches introductory graduate statistics courses. He has a traditional class that meets in a well-equipped multimedia classroom. His classes are videotaped. That video is compressed and streamed to distant students. While the quality of the streamed video continues to improve, it hardly approaches high definition. Nevertheless, this approach has been very successful. To offer improved video quality, Ansorge is experimenting with providing at least some of the course video on a CD-ROM that is mailed to the online-only students.

Ansorge uses the *eGrade* program developed by John Orr (Chapter 15) for practice tests, and for the online students taking the real tests. Tests for the course are proctored whether the students are on-site or distant. Students working from a remote location are required to identify a proctor according to specific guidelines set up by Ansorge. Ansorge's approach represents an excellent compromise between traditional and distance formats.

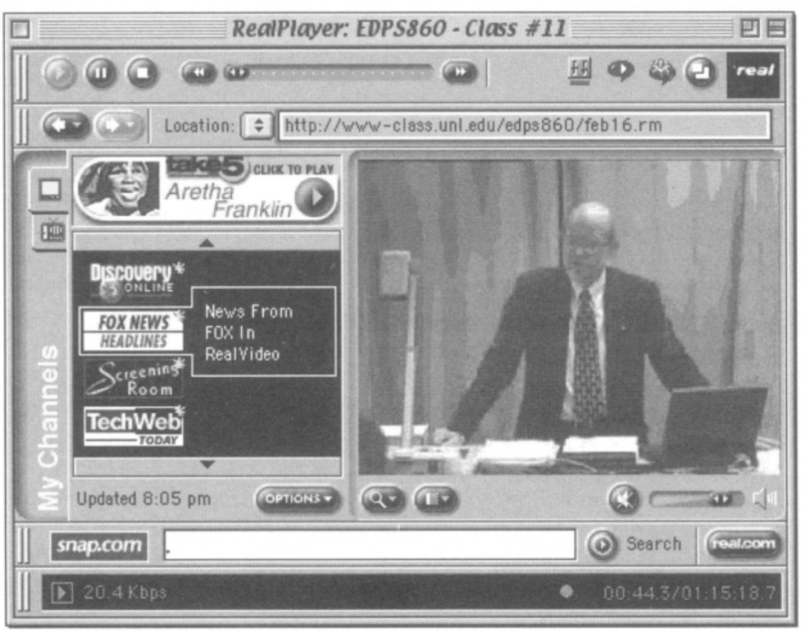


Figure 12.03. Streaming video of Charles Ansorge's Applications of Selected Advanced Statistics course.

## German On-Line Distance Education Network – GOLDEN

German On-Line Distance Education Network is an interactive, online, teacher development program of study for teachers of German. Six courses are available. A course on the use of modern telecommunications materials in teaching German, written by Donna Van Handley and taught by her together with Aleidine Moeller, is illustrated in Figure 12.04.

The submitted writings in this class are captured in a journal that remains accessible to them throughout the course. Other activities in this course series include listening to an audio tape (played online), and then discussing the tape. This represents a remarkable effort to engage teachers who otherwise would have little access to professional development.

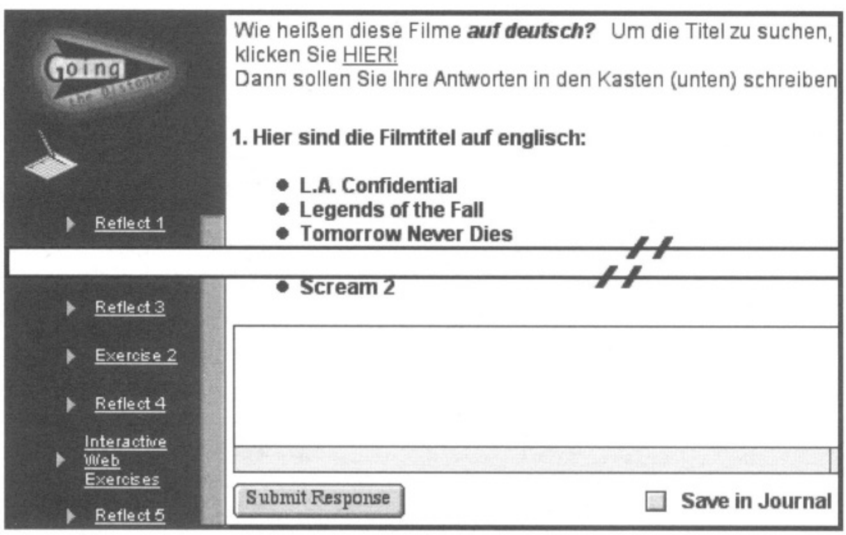


**Figure 12.04. Modified screen capture from online course for teachers of German. The teachers are expected to complete the instructions (by writing in German), and submit their writing.**

## Diversity in American Literature – Xroads

Class.com offers a series of high school courses offered through the Division of Continuing Studies at the University of Nebraska. The award winning American Literature I: Diversity in American Literature – Xroads is an example of the courses provided. Class.com courses include CD-ROMs to provide the student with files for use at their own computer. Using this software, the client browser first seeks files on the ROM rather than from the server. Access time for large multimedia files is reduced. Revised files still can be downloaded as needed. The result is that Class.com courses include rich, interactive, multimedia environments as illustrated in Figure 12.05.

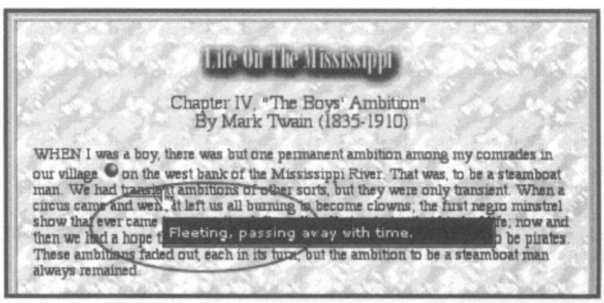


**Figure 12.05. Course materials from Class.com include many teaching devices. When the cursor (hand pointer) enters the word transient, a definition for that word pops up on the screen.**

> In this American literature course offered via the Web, students explore the themes of technology, language, illusion, and independence. Students read culturally diverse selections within such differing genres as the essay, short story, novel, historical writings, and poetry. Through multimedia presentations, selections provide vocabulary enrichment, textual insights, and audio readings of excerpts to enhance the learning experience.
>
> Students will develop critical thinking and learning skills by taking quizzes, completing creative projects, and sharing their thoughts in newsgroups, or one-on-one with the teacher or other students. Basic computer skills are recommended.
>
> class.com {U12.03}

## JavaScript for Educators: An Introduction

UCLA Extension offers a large array of online courses, including some certificate and degree programs. One such course deals with JavaScript, a programming language used to make Web pages interactive. To determine whether we would outsource a low enrollment course at Nebraska to UCLA, a student took this course on an experimental basis. His experience was high quality. He learned good introductory skills in JavaScripting (Figure 12.06).

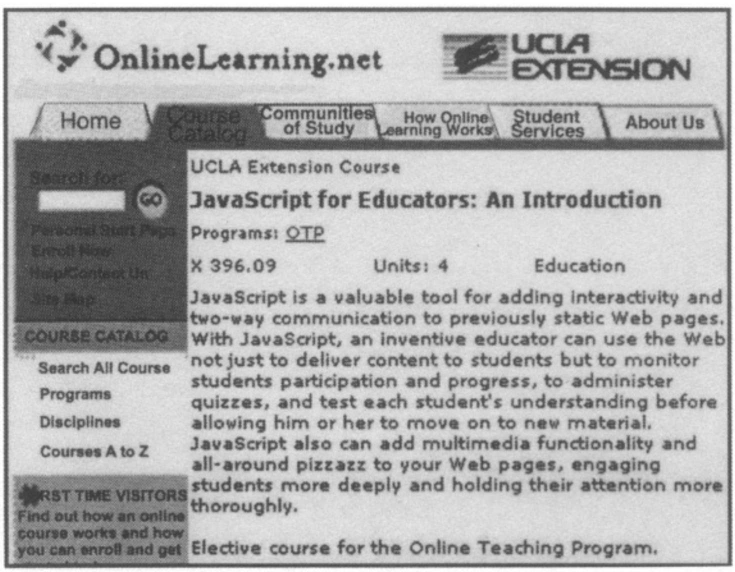


Figure 12.06. JavaScript for Educators {U12.04}, a course offered by UCLA Extension.

## Cultural Anthropology

Ohio University offers Cultural Anthropology online, but requires onsite testing. According to the course description {U12.05}, "All course content is presented on the World Wide Web; e-mail is used for submission of assignments, as well as for the instructor's evaluation and comments. Five 50-minute video programs are available to supplement the course materials. These are not required for the course, but they are recommended to enhance students' understanding of other cultures and the ways in which anthropologists study the various aspects of culture."

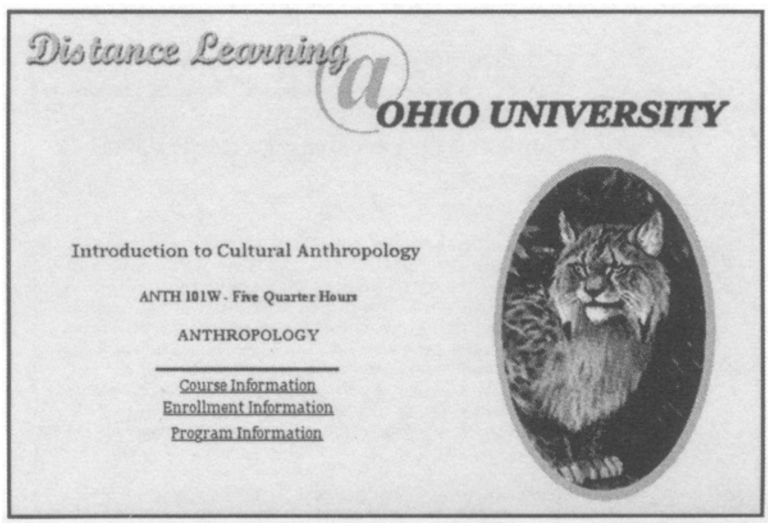


Figure 12.07. **Cultural Anthropology at Ohio University. With permission.**

## Critical Thinking

Mission Critical {U12.07} is the principal resource for students taking a course in critical thinking {U12.08}. The Web materials provide an extensive tutorial. Students receive both reading and activity assignments. There are two formal essays, and four proctored tests.

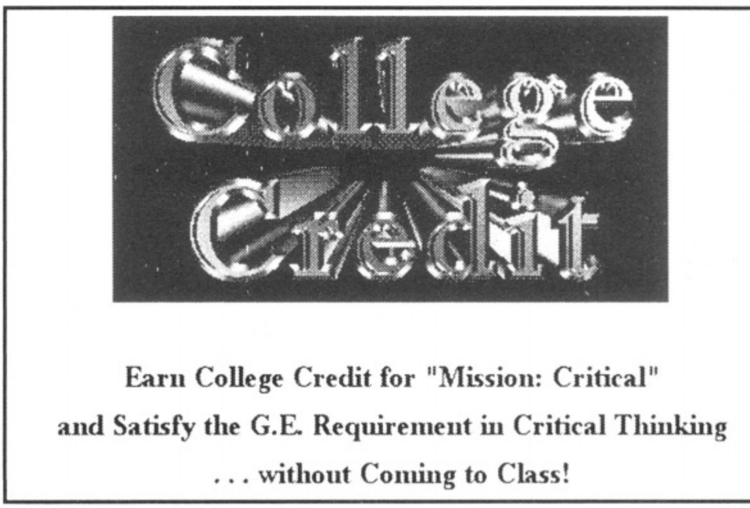


Figure 12.08. College credit is offered based upon the Mission Critical.

## History of Ideas Online

Three schools, Mississippi State University, Centenary College, and San Francisco State University have combined to produce the course History of Ideas Online {U12.06}. Except for copyrighted readings, the course is available to the public online. During active semesters, the public is allowed to participate in discussions. Self-regulation is encouraged by the stated course requirements and grading policies.


Figure 12.09. **History of Ideas Online, a collaboratively developed course.**

## URLs

U12.01. Stanford Online, http://stanford-online.stanford.edu/ (accessed 6/17/00).
U12.02. Chemistry 869A, Water and Solutions. http://129.93.84.115/Teacher/NSF/C01/C01.html (accessed 3/30/00).
U12.03. American Literature 1: Diversity in American Literature–Xroads, http://www.class.com/registration/showclass.asp?courseID=ENGH+041 (accessed 5/26/00).
U12.04. JavaScript for Educators: An Introduction, http://www.onlinelearning.net/CourseCatalog/CourseDetail.cfm?s=329.e050i801h.075j322661&CID=1000099108 (accessed 5/26/00).
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U12.07. Mission Critical (College Credit), http://www.sjsu.edu/depts/itl/graphics/credit.html (accessed 6/17/00).
U12.08. History of Ideas Online Main Page, http://aristotle.philosophy.msstate.edu/H-Ideas/index.html (accessed 6/17/00).

# CHAPTER 13

# Informal Education: Museums, Organizations

Today nearly every group or organization seems to have a Web site. For museums and for organizations with special purposes such as the National Arbor Day Foundation or the Audubon Society, a Web site can play a variety of important roles.

The term museum implies the existence of a collection, usually an organized collection. It implies that at least part of the collection will be available for access, either public, academic, or some other designated access. A major question that any museum can ask itself relates to how much of its information should be displayed on the Web. For a children's museum, where the collection may consist entirely of constructed exhibits or things not widely regarded as collectable, putting information on the Web is low risk. For an art museum, this may be an entirely different matter. Most museums depend upon revenue streams that relate to attendance, and whatever is made public puts attendance at potential risk.

For the present, at least, museums appear to favor making their collections available for some use on the Web. The experience of visiting a museum on the Web is very different from visiting it live. The Melbourne Museum {U13.01}, perhaps the first major new museum to open its door in this millennium, has been planned from the outset to have a major technological outreach program. Milekic addressed the issue of making digital information in virtual museums child friendly {U13.02}.

Museums certainly are interested in using the Web. An annual conference, *Museums and the Web* {U13.03}, seems to be thriving. Early graduates of the UNL Museum Studies program have been rewarded by employers for any

training they received in Web use. Reports are emerging regarding the use of museum sites by “virtual visitors” [Johnson, 2000].

There is a big difference between a Web site for a teacher in a course, and a museum. The students in a class may have to come to a site for information. So, the site need not be especially efficient or attractive. For a museum, it is likely that return visits and word-of-mouth referrals will happen only if the site is both attractive and efficient.

## INFORMAL EDUCATION

Education that takes place outside of school settings, especially that connected with museums and organizations, is called informal education. A vital statistic for any museum is the amount of time visitors spend at an exhibit. Thirty seconds is a typical exhibit interaction time.

All museums open to the public, whether or not accessed by a fee, depend upon attendance for much of their funding. Neither agencies nor benefactors are likely to lavish resources upon a museum that no one visits. A major question for a museum, therefore, is how much of its collection should it display at a Web site? This question remains largely unanswered as of this writing.

On the other hand, museum visitors with a focused visit strategy show greater learning from their visits than do casual visitors [Falk et al., 1998]. It is clear that effective use of a Web site could help a visitor focus a museum visit. While the net impact of having an extensive Web site upon the total number of visitors is uncertain, such a site can enhance the impact of a visit. And such a Web site certainly allows people all over the world to have the pleasure of being a virtual visitor.

## MUSEUM SITES

### Metropolitan Museum of Art

The Metropolitan Museum of Art (New York) {U13.04} has a very attractive, extensive site. When you first access the site, you are engaged by something related to current exhibits as in Figure 13.01. This page changes daily. Visitors to this virtual museum must click further to reach a menu-oriented screen.

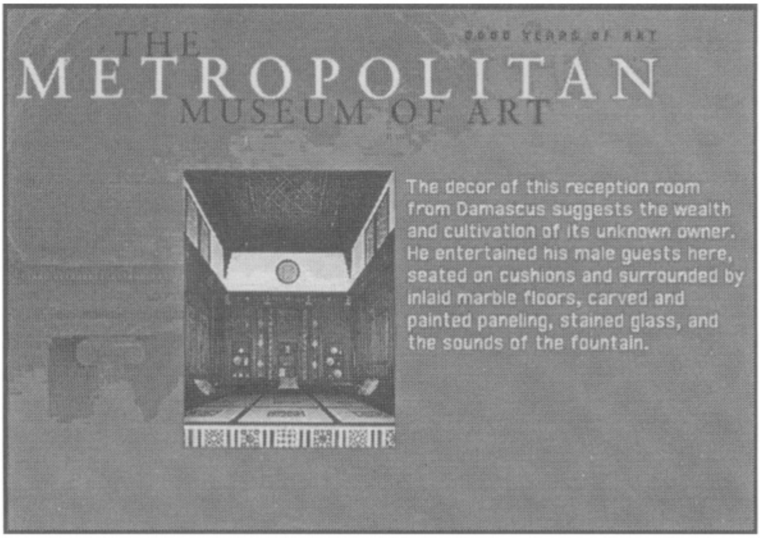


Figure 13.01. Partial opening screen of a Web visit to the Metropolitan Museum of Art, New York, on Sunday. March 4, 2000. Copyright © 2000 The Metropolitan Museum of Art. All rights reserved. With permission.

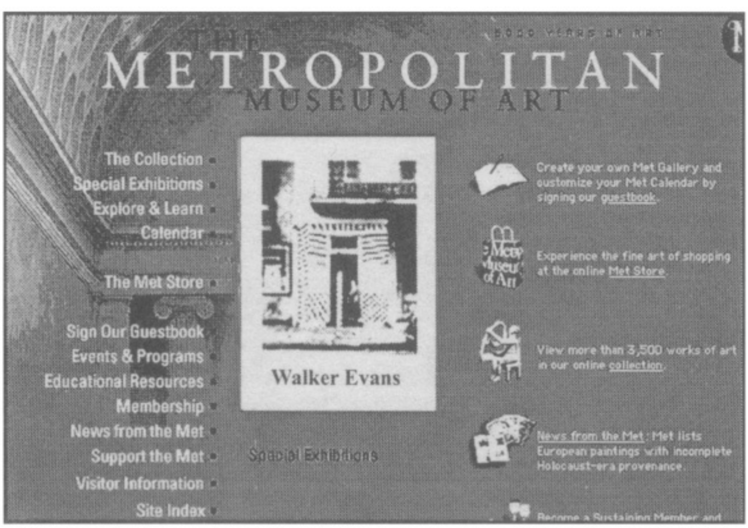


Figure 13.02. Menu-like Web screen from a Web visit to the Metropolitan Museum of Art, New York, on Sunday. March 4, 2000. Copyright © 2000 The Metropolitan Museum of Art. All rights reserved. With permission.

A large portion of the Met's collection is presented elegantly at this Web site. There is an extensive, attractive Web store. Museum memberships are offered, and with Met membership comes Museum store discounts. There are significant educational resources. The teacher resources are more local than national; they appear intended to support visits to the museum.

## Exploratorium

The Exploratorium (San Francisco, CA) {U13.05} is a premier science museum known worldwide for its interactive exhibits. The Exploratorium's Web site contains schedules, exhibits, live broadcasts, links to other sites, membership information, and an online store.

The Exploratorium Web site features clever, well-thought-out, interactive exhibits. Links to other sites are maintained. There is a Web store, and memberships are sold online.


Figure 13.03. **A Web visit to the Exploratorium. This site includes online, interactive exhibits. Reproduced with permission. ©Exploratorium®, www.exploratorium.edu.**

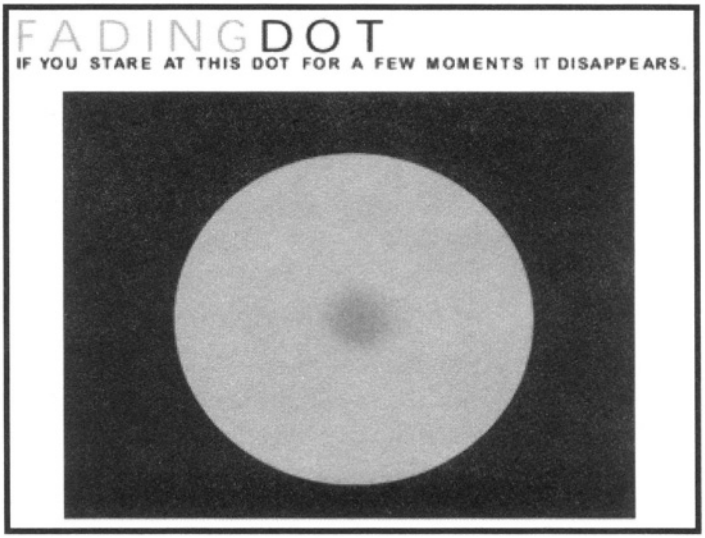


Figure 13.04. A Web visit to the Exploratorium. The fading dot exhibit. {U13.06} ©Exploratorium®, www.exploratorium.edu

### The Stuhr Museum of the Prairie Pioneer

The Stuhr Museum of the Prairie Pioneer (Grand Island, Nebraska) {U13.07} is devoted to early life in the Plains States, especially Nebraska. It has a Web site which affords many of the same features as the larger museums, but much less is automated and online. The education program described at the site specifies activities by grade level, K-6.

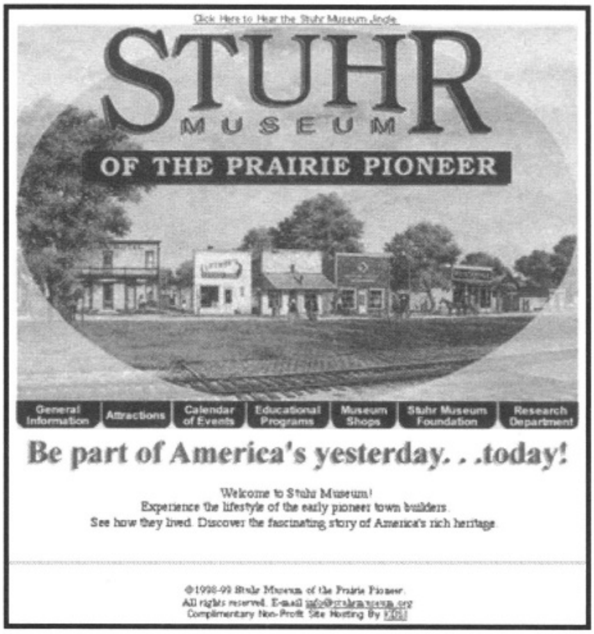


Figure 13.05. The Web site for the Stuhr Museum of the Prairie Pioneer contains many of the features found at larger sites. As of this writing, the site was less systematic in its commercial activities (sales, memberships) than were those of the larger museums. With permission.

## Museums of Paris

Sometimes information from several museums is gathered together in a single Web site. The site for art museums in Paris, France, is very useful.

Musées de Paris - P

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z - English Version

- Palais de Tokyo - 75116
  Photographie , Techniques
- Galerie du Pantheon Bouddhique du Japon et de la Chine - 75116
  Archéologie , Arts Décoratifs , Histoire , Joaillerie , Mobilier , Peinture , Photographie , Sculpture , Textile
- Musée Pasteur - 75015
  Arts Décoratifs , Peinture , Sciences , Sculpture
- Pavillon de l'Arsenal - 75004
- Pavillon des Arts - 75001
  Archéologie , Arts Décoratifs , Ethnographie , Histoire , Joaillerie , Littérature , Médailles , Mobilier , Peinture , Photographie , Sculpture , Textile
- Musée du Petit Palais - 75008
  Arts Décoratifs , Mobilier , Peinture , Sculpture , Dessins , Gravures , Livres
- Musée Edith Piaf - 75011
  Arts Décoratifs , Joaillerie , Mobilier , Peinture , Photographie , Sculpture , Textile , Timbres

Figure 13.06. The Web site for Museums of Paris {U13.08}. With permission.

## ORGANIZATION SITES

Special purpose organizations have a great deal to gain and little to lose from developing Web sites. A Web site can extend the reach of their message at very low cost. It can be an effective fundraiser. It can support educational programming. Modern politicians have supported and embraced the use of the Internet. Clearly, Web sites played an important role in some national campaigns of 2000. The role of Web sites is quickly growing for a wide variety of organizations. The URLs of non-profit organizations are usually identified with the ".org" designation.

### National Audubon Society

The National Audubon Society {Ul3.09} has a fairly comprehensive site. The national site links to information on topics of interest to members, membership information, the chapter sites, and a store. The National Audubon Society has a policy that all of its various chapters serve from the same Web server.

Networking between persons of like interests has been facilitated enormously by the Web. One link available from the Audubon site is a signup

for the Classroom Feeder Watch {U13.10}, a research program supported through the Cornell University Laboratory of Ornithology.{U13.11} Through this particular project, researchers attempt to involve self-identified classrooms as observers.

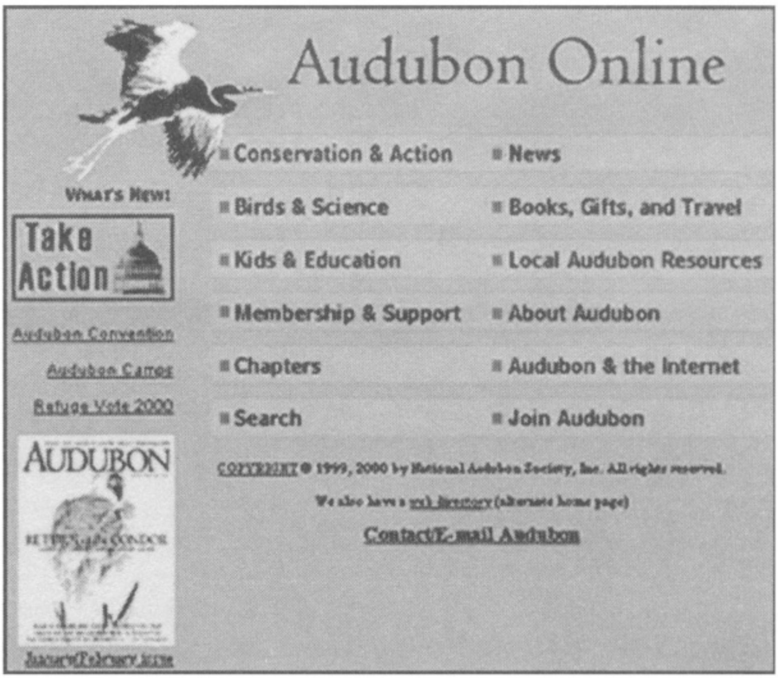


Figure 13.07. The Audubon Society Web site. With permission.

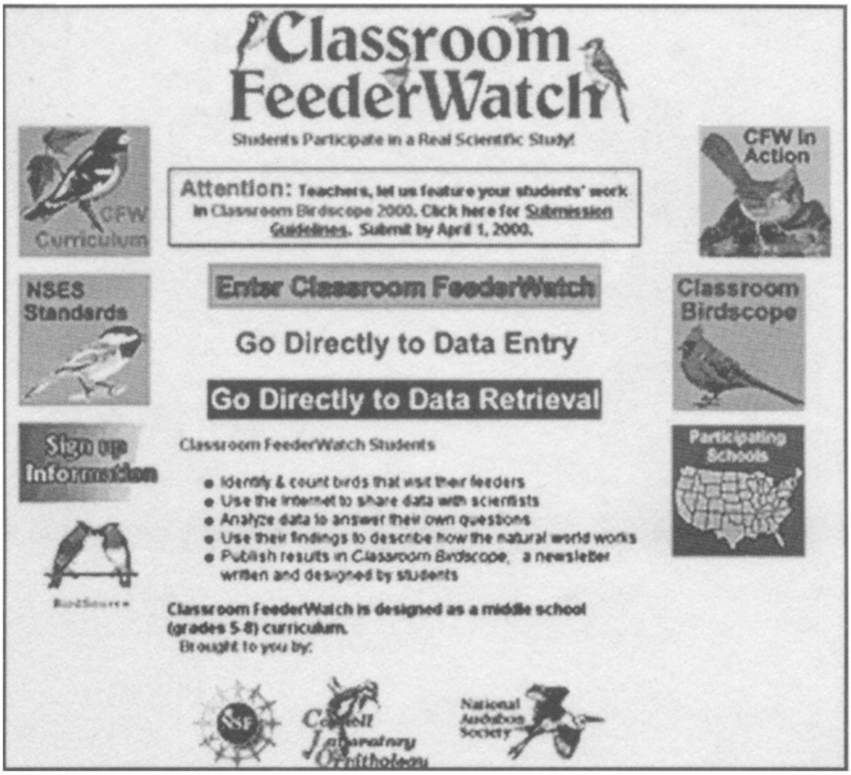


Figure 13.08. The Classroom Feeder Watch program, accessed from the National Audubon Web site. This is an example of how the Web extends a community of interested learners, and makes them more active as participants. With permission.

## American Chemical Society

The American Chemical Society {U13.12} maintains an extensive Web site. Most of the services available from this site require membership or must be purchased. The library of online journals may be searched for topics, and abstracts are available online free of charge.

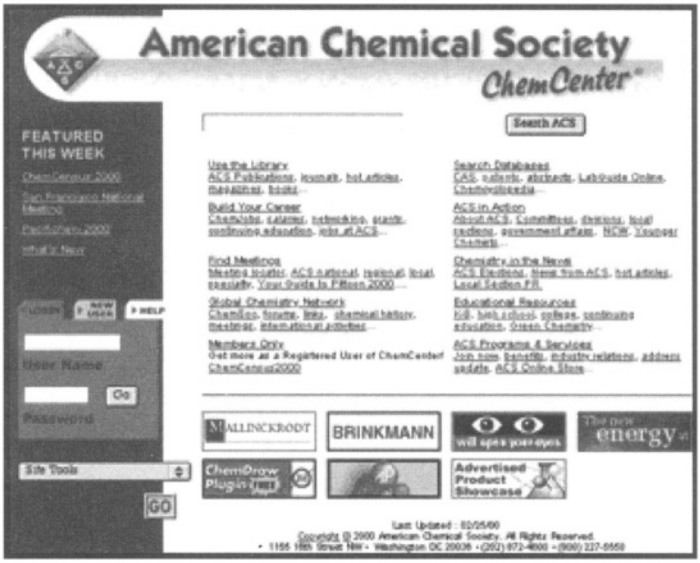


Figure 13.09. The American Chemical Society's ChemCenter Web site. With permission.

## American Academy for Asthma, Allergy, and Immunology

Professional organizations of all sorts also maintain Web sites. For example, see the American Academy for Asthma, Allergy, and Immunology site {U13.13}. This professional organization's Web site is rich with information about the diseases treated by the organization's members. As such, it is a valuable resource for students and teachers. At the same time, the site provides significant services for members. By entering a Zip code, users can retrieve lists of physicians specializing in the treatment of allergies and immunological deficiencies.

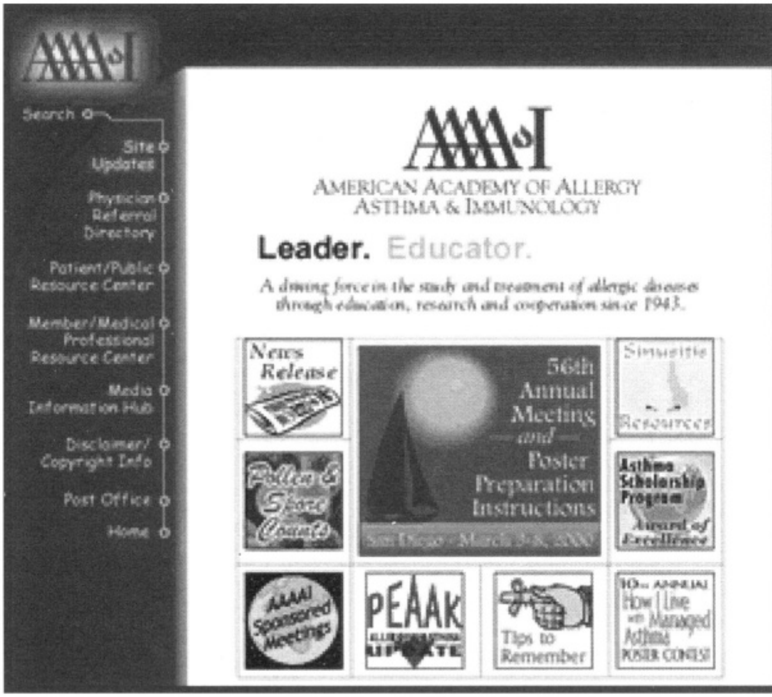


Figure 13.10. The American Academy for Asthma, Allergy, and Immunology Web site. With permission.

## TUTORIALS

In addition to commercial and educational tutorials, there are informal sources of short tutorials or courses online at Web sites like SmartPlanet.com {U13.14}. This site offers courses contributed by members or organizations in eight different major topics. Some of the courses require a fee to participate while others are free. Courses are offered in two different formats: self-study and instructor led. Courses are at three levels of expense: free, standard, and premium. Participation in courses requires signing up for free membership; for a monthly fee, a "Standard" membership includes registration in both the free and standard courses.

While many Web materials look and feel as if designed for particular courses, the Web is rich with general information. It is like a worldwide public library. Where better to go to learn about this library than a library? {U13.15} (Figure 13.11).

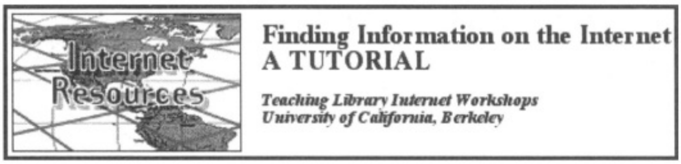


Figure 13.11. U. C. Berkeley's tutorial for finding information on the Internet.

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U13.05. Exploratorium, http://www.exploratorium.edu/ (accessed 5/23/00).

U13.06. Exploratorium: Fading Dot, http://www.exploratorium.edu/exhibits/fading_dot/fading_dot.html (accessed 4/2/00).

U13.07. The Stuhr Museum of the Prairie Pioneer, http://www.stuhrmuseum.org/ (accessed 4/2/00).

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U13.12. American Chemical Society, http://www.chemcenter.org/ (accessed 4/2/00).

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U13.15. Finding Information on the Internet: A TUTORIAL, http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/FindInfo.html (accessed 6/17/00).

# CHAPTER 14

# Using Databases

The emergence of Web-friendly interactive databases has been fueled by eCommerce. Education is also benefiting from the development of friendlier tools to create interactive Web page components. It is now possible to choose from several strategies to incorporate interactive components into your online course. The potential applications for such software in teaching are enormous.

A database is a collection of data organized so that its contents can be readily accessed, managed, and updated. Using database applications in conjunction with Web pages allows the text, graphics, and feedback displayed on a page to be rendered dynamically at the time the page is requested. This allows the instructor to customize pages, and to provide feedback and information relative to conditions or matching fields for each individual user. Most of the courseware packages have database functions built into them. However, if you are interested in adding customized interactive components and Web pages for your students, selecting a database application to use with your Web site will add a wide range of interactive options to your course design.

## DATABASES

Using databases at your Web site adds functionality at two different levels. You can use the power of the features in the database application itself. You also can use some advanced HTML and/or Javascript coding to create interactive components.

Most designs for using databases are based on an interactive exchange of information between the user and the server. HTML code can request that information from a database field or record be displayed on a Web page. At commercial Web sites, the user requests specific information to be displayed.

The user can send a query or submit information to the site, or search a site and only view the relevant information.

Similar functions can be applied to online course design. There are some real advantages to adding a component that allows the server to get information from a user and return specific information as a result of the interaction. Some examples of how a database application might be used in Web-based environments would include:

- discussion forums
- data entry
- selected display on dynamically rendered pages
- search and display functions to select information to view
- quiz/test functions
- feedback display
- shared student work spaces for projects

The combination of a database and HTML really allow the instructor to create specific or unique interactive features for their Web site. The two main reasons to use a database application with your Web pages are to customize information displayed on pages, and to collect data by allowing users to submit information using HTML forms.

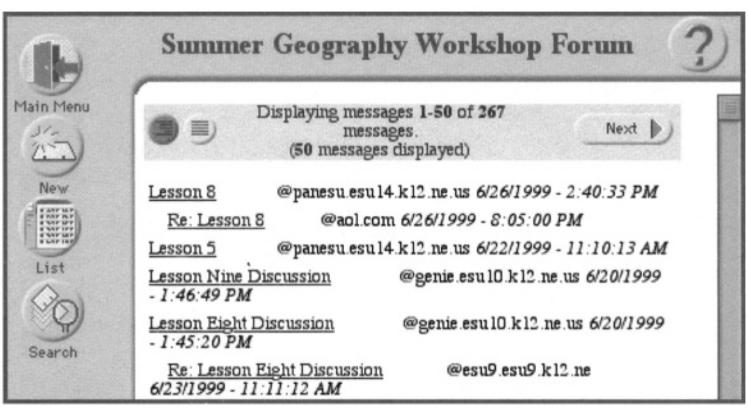


Figure 14.01. Discussion forum application created in *FileMaker Pro*.

There are several advantages to using a database to render Web pages dynamically rather than to create static Web pages. Rendering a Web page reduces the number of pages that must be created and stored. Imagine the time-

intensive labor involved if every item for sale at Amazon.com required its own HTML file stored on a server.

Web pages generated from database information are easily customized. An instructor can customize course information or feedback about an assignment or a student's progress. The information displayed on the page can be based on a user login and password that matches fields in a database. When the user is identified, specific fields from the database can be displayed to show which assignments have been completed, and the grade for each complete assignment.

Partially completed assignments and works in progress can be displayed, and the changes saved as several students contribute to the same project. The instructor can design the access to the project such that the contributions of individual students are tracked. Whiteboard and video conferencing software contain features that allow for synchronous use on a shared file by more than one user.

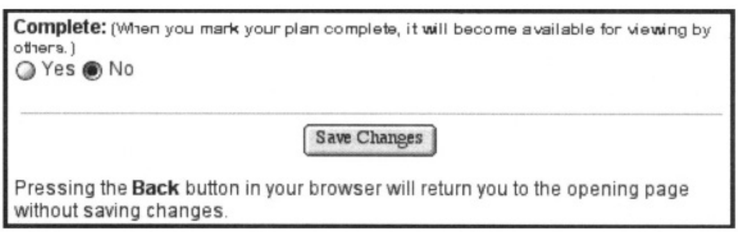


Figure 14.02. **Submit button on a shared workspace page that creates the action to save changes to a database field where it can be accessed and displayed as an evolving document.**

Dynamic Web pages can support a two-way exchange of information. Sometimes that information can be used solely for determining a response. However, there are more options when designing the interaction. The instructor can maintain complete control over the list to ensure the materials are all appropriate, or make the list interactive and allow students to contribute links they have discovered.

If an instructor wants students to contribute URLs for a class resource page, students can e-mail URLs to the instructor and the instructor can manually edit the lists and add them to the Web site. But it is more efficient to automate the process of submitting and posting the URLs. By creating a form for submitting the URLs directly to the database, the instructor will reduce the workload of updating and maintaining the Web page to display the URLs from the database. The instructor can choose to add a search function to allow users to view only the URLs contributed after a specific date or in a specific content area.

**Find URLs for 3 DIFFERENT teaching sites that make use of interactivity. That is, find sites that demand inputs from the user, and give the user
feedback based upon their input.**

**1234**
ART
http://www.eduweb.com/pintura/index.html

ENGLISH
http://eduplace.com/tales/

LANGUAGE/ MATH/ READING
http://www.funbrain.com/

**5678**
The Biology Project, University of Arizona. Click on Guided Tour and select one of the subjects to interact with. If your answer is wrong you get a tutorial.
http://www.biology.arizona.edu/

Interactive physics, math, geometry, etc. Need VRML plug-in.
http://id.mind.net/~zona/index.html

Great artist web page. Interactive drawing, tracing, creating. Try "You Choose" option
http://www.kn.pacbell.com/wired/art/art.html

Many sites I hit that touted being interactive were one way. You did not enter in material and get responses. You did activities on paper or with other materials, but no graphic interfacing occurred. Several sites needed plug-ins that I didn't have. I went through the process to get the VRML for the id.mind page, but in trying to download Quick-Time 4.0 for another page I gave up when the download failed. The id.mind page allows you to graph trig and analytic geometric functions, but I don't know that you get right and wrong answers back. The Biology site will check your answers and give you a tutorial if you are wrong. The more I searched the art page I'm not sure how interactive it is. I did find a quiz were your answers are checked.

Figure 14.03. **In this course, students used a Web form to submit responses to an assignment into a database (*HyperCard*).**

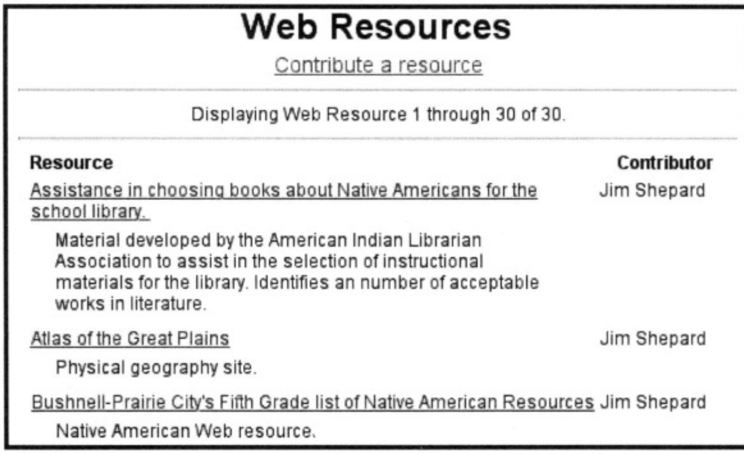


Figure 14.04. **Web resource list for a course displayed dynamically by a database application.**

Most database files can hold all types of information: text, numeric values, and graphics. Number or value fields might be calculated fields that provide individualized user feedback. Images might be stored to create an instructional resource, or to display an image of each student on a course participant page. A field might be used to record what has been displayed randomly to a learner.

The possibilities for designing interactive components with a large variety of features are extensive.

## Selecting Software

Many database applications are available. *FileMaker Pro* and Microsoft *Access* are common choices. We have used *HyperCard* (Macintosh only) in an extremely wide array of applications. *SuperCard* (Macintosh only) and *ToolBook* (Windows only) enjoy extensive use as database applications. Each program has different features and limitations.

Consider the challenge of creating the 18 1-credit graduate courses for high school chemistry teachers mentioned in Chapter 12. In these courses, some of the content is created from scratch, but most of it comes from the Web. Many people are involved in creating each of the courses. All of their efforts need to be merged into18 course entities. This problem was addressed using *HyperCard.* A file was created with a record for each course syllabus; 18 contents files in all. Each record included all of the HTML coding that was to be used for an entry, as well as identifiers for each quiz item connected to the entry. For each course, a second database file was created consisting of the quiz items for that course. Both databases are used online. As a student works through each course, a

record is kept of the objectives completed. As the objectives are completed, new pages are calculated for each student reflecting progress through the course. The quiz items are created "on-the-fly." Each item is encoded as it is sent out. When it comes back with a student response, the answer is checked and appropriate tutoring is provided automatically. See Course 1 in this series {U14.01} as an illustration from the student's perspective. The testing for this course is described in Chapter 15.

### Tools to Build the Interface

The server must be able to communicate the input information to the database. There must be some structure to handle this interaction. Prior to selecting a database application, consult the server administrator to find out if there are any limitations about which applications or formats will run on the server. There are several options depending on the operating system and Web server software being used on the machine. Many times Common Gateway Interface (CGI) scripts handle the incoming information submitted by the user, and the resulting feedback from the database file.

A popular option for Microsoft Windows NT servers is the application, **Active Server Page (ASP)**. ASP {U14.02} involves embedded, server-side scripts used to serve interactive pages. It includes both a file-access and a database-access components. *Access 97* can create ASPs to connect live databases online. It doesn't allow the user many options for customization [Hart, 1998]. Additional and more complex information can be accessed from online tutorials on ASPs {U14.03}.

The "Web Companion" feature in *FileMaker Pro* eliminates the need for CGI scripts and performs this task. The Web Companion feature must be enabled; when enabled, it sets up its own server software. All of the database files and HTML files that need to communicate are housed in a Web folder in the *FileMaker Pro* application folder. Along with the "Web friendly" features provided, most applications also have increased security features. Assigning logins and passwords to control access to the database file is a good idea, especially if it contains any type of sensitive information such as grades or ID numbers.

*FileMaker* has an associated language, CDML (Claris Dynamic Markup Language). This language may be used to link the information from forms on Web pages to *FileMaker* databases. *HomePage,* a Web page creation program, facilitates the creation of pages with forms that use CDML to link to *FileMaker* databases.

### Professional Databases; Cookies

The databases we have mentioned are quite powerful. In some situations, however, application programs capable of handling very large databases are required in order to provide either the size or speed needed to support a process. Most of us in education never face this level of demand. In a few situations, however, this demand is possible. There are competing standards and products. SQL (Structured Query Language) is a standard (**ANSI**, **ISO)** interactive and programming language for getting information from and updating a database. Professional programming assistance is usually necessary to work with a major database software package.

**Cookies** are small text files that are written on the client's hardware that become available to browsers. The user of the browser software must give permission before a cookie can be written. Permission can always be granted, always denied, or obtained on a case-by-case basis. As often as not, eCommerce sites use cookies to manage their relationships with customers. After the first time you do business with an eCommerce site, they seem to know a great deal about you. When you first log on, the business writes a cookie to your hard drive. Thereafter, when you log on, it uses this cookie to get enough information to search you out in its own database and decide what offers to recommend to you. The important data is at the eCommerce site; the cookie is what gives them the opportunity to know what to offer you. These schemes are heavily protected; before any key information is displayed, the user of the browser software will need to offer some verifying information. Cookies are useful tools. In a well-managed educational site, for example, a cookie is a means for starting a reentering student at the same place she left a structured instructional sequence.

## ACTIVITIES

There are numerous database resources in the public domain. It is reasonable to ask students to use readily accessible data to gather information. It is better to have the students put the information to use. When reading scores were published on a school-by-school basis in Lincoln, Nebraska, an instructor at UNL had students create a 3-D map of the city. For each school, reading scores and average family incomes were plotted, showing a remarkable positive correlation.

### Statistics

The Web is becoming a rich source of statistics. This is an interesting phenomenon, because many persons once profited from the sale of statistical information that is now freely accessible on the Web. A remarkable source on

information is the U. S. Census Bureau site {U14.04}. An illustration of the kind of information available is shown in Figure 14.05.

Projections of the Total Population of States: 1995 to 2025

(Numbers in thousands. Resident population. For more detailed information, see Population Paper Listing #47, "Population Projections for States, by Age, Sex, Race, and Hispanic Origin: 1995 to 2025.")

| SERIES A | July 1, 1995 | July 1, 2000 | July 1, 2005 | July 1, 2015 | July 1, 2025 |
|---|---|---|---|---|---|
| Alabama............. | 4,253 | 4,451 | 4,631 | 4,956 | 5,224 |
| Alaska.............. | 604 | 653 | 700 | 791 | 885 |
| Arizona............. | 4,218 | 4,798 | 5,230 | 5,808 | 6,412 |
| Arkansas............ | 2,484 | 2,631 | 2,750 | 2,922 | 3,055 |
| California.......... | 31,589 | 32,521 | 34,441 | 41,373 | 49,285 |
| Colorado............ | 3,747 | 4,168 | 4,468 | 4,833 | 5,188 |
| Connecticut......... | 3,275 | 3,284 | 3,317 | 3,506 | 3,739 |
| Delaware............ | 717 | 768 | 800 | 832 | 861 |
| District of Columbia | 554 | 523 | 529 | 594 | 655 |
| Florida............. | 14,166 | 15,233 | 16,279 | 18,497 | 20,710 |
| Georgia............. | 7,201 | 7,875 | 8,413 | 9,200 | 9,869 |
| Hawaii.............. | 1,187 | 1,257 | 1,342 | 1,553 | 1,812 |
| Idaho............... | 1,163 | 1,347 | 1,480 | 1,622 | 1,739 |
| Illinois............ | 11,830 | 12,051 | 12,266 | 12,808 | 13,440 |
| Indiana............. | 5,803 | 6,045 | 6,215 | 6,404 | 6,546 |
| Iowa................ | 2,842 | 2,900 | 2,941 | 2,994 | 3,040 |
| Kansas.............. | 2,565 | 2,668 | 2,761 | 2,939 | 3,108 |

Figure 14.05. **Sample population projections available through the U. S. Census Bureau site.**

## Maps

A very practical example that combines text and graphic information is the generation of maps of specific locations. Figure 14.06 shows a map generated from a database.

Web-generated maps are of considerable practical importance. When planning a trip, you can generate maps that are very specific for the given trip. Essentially any level of resolution is possible; printing fine grain maps for the beginning and end of a long trip is a straightforward matter. Web-based map databases usually ask that you enter an address, a Zip code, or an airport code. Most services provide estimates of both mileage and driving time.

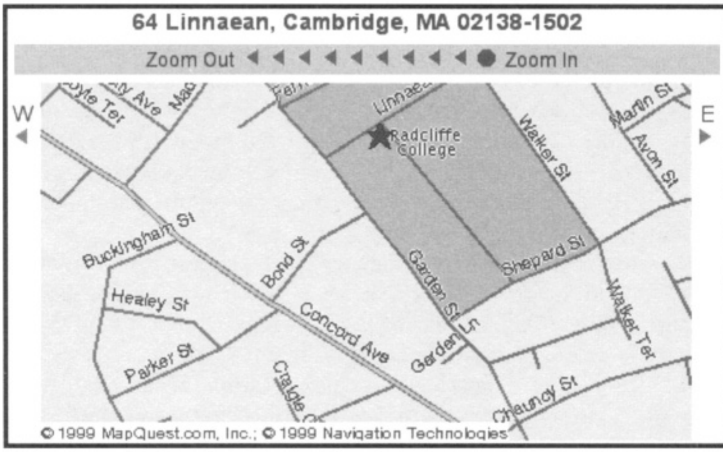


Figure 14.06. **Modified screen capture of a map generated from a database of textual information. Generated by Yahoo! Maps {U14.05}. With permission of MapQuest.**

## Scientific

The Web is a place where scientific data abounds. For example, data are available for the best estimates of the atomic masses of all known nuclides (atoms), as in Figure 14.07.

MASS LIST
for analysis

| 1N-Z | | N | Z | A | EL | O | MASS EXCESS (keV) | | | ATOMIC MASS (micro-u) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 1 | n | | 8071.323 | 0.002 | 1 | 008664.923 | 0.002 |
| | -1 | 0 | 1 | 1 | H | | 7288.969 | 0.001 | 1 | 007825.032 | 0.000 |
| 0 | 0 | 1 | 1 | 2 | H | | 13135.720 | 0.001 | 2 | 014101.778 | 0.000 |
| 0 | 1 | 2 | 1 | 3 | H | | 14949.794 | 0.001 | 3 | 016049.268 | 0.001 |
| | -1 | 1 | 2 | 3 | He | | 14931.204 | 0.001 | 3 | 016029.310 | 0.001 |
| 0 | 2 | 3 | 1 | 4 | H | -n | 25927.784 | 109.545 | 4 | 027834.627 | 117.601 |
| | 0 | 2 | 2 | 4 | He | | 2424.911 | 0.001 | 4 | 002603.250 | 0.001 |
| | -2 | 1 | 3 | 4 | Li | -p | 25320.173 | 212.132 | 4 | 027182.329 | 227.733 |
| 0 | 3 | 4 | 1 | 5 | H | -nn | 36833.979 | 947.692 | 5 | 039542.911 | 1017.390 |
| | 1 | 3 | 2 | 5 | He | -n | 11386.234 | 50.000 | 5 | 012223.628 | 53.677 |
| | -1 | 2 | 3 | 5 | Li | -p | 11678.880 | 50.000 | 5 | 012537.796 | 53.677 |
| | -3 | 1 | 4 | 5 | Be | x | 37996# | 3996# | 5 | 040790# | 4290# |
| 0 | 4 | 5 | 1 | 6 | H | -3n | 41863.763 | 264.906 | 6 | 044942.608 | 284.389 |
| | 2 | 4 | 2 | 6 | He | | 17594.123 | 1.014 | 6 | 018888.072 | 1.089 |
| | 0 | 3 | 3 | 6 | Li | | 14086.312 | 0.475 | 6 | 015122.281 | 0.510 |
| | -2 | 2 | 4 | 6 | Be | - | 18374.465 | 5.468 | 6 | 019725.804 | 5.871 |
| 0 | 3 | 5 | 2 | 7 | He | + | 26110.264 | 30.004 | 7 | 028030.527 | 32.210 |
| | 1 | 4 | 3 | 7 | Li | | 14907.673 | 0.473 | 7 | 016004.049 | 0.507 |
| | -1 | 3 | 4 | 7 | Be | | 15769.489 | 0.472 | 7 | 016929.246 | 0.507 |
| | -3 | 2 | 5 | 7 | B | +3n | 27867.864 | 70.712 | 7 | 029917.389 | 75.912 |

Figure 14.07. **Modified table of atomic masses {U14.06}.**

## WEB RESEARCH AND ASSESSMENT

A principal theme of this book is that decisions about instruction should be based upon research where possible. The Web will be used in teaching because it is fast becoming the internationally predominant medium for communication. The Web is a marvelous system for delivering multimedia instruction. However, as we noted early and repeatedly, the use of multimedia in instruction, by itself, does not often lead to improved learning.

The remarkable thing about the Web, however, is that it affords the opportunity to study learners in a fashion heretofore not possible. Crippen et al. [2000] report details of student use of a Web site designed to help them prepare for a specific item on the Advanced Placement Chemistry Test. This is an example of using Web databases to gather information about learning. This particular site gathers information about both access and performance. As indicated in Chapter 9, distributed practice leads to improved learning performance as compared to concentrated practice. A major finding in the study of the AP Chemistry site is that students hit the site most frequently during the week before the AP Chemistry Test, with the day before the test being the peak day. Unpublished observations by Orr [2000] suggest that student procrastination until the last moment before a course deadline can be so serious as to create server problems due to heavy traffic.

Servers can maintain logs that capture varying degrees of information. Figure 14.08 shows a modified screen capture of a server log. The log file is a text file. It is possible to import files of server logs directly into database software for analysis. If you go to the trouble of setting up a learning Web site, especially one with new materials, then using the information from that site to study student learning seems prudent.

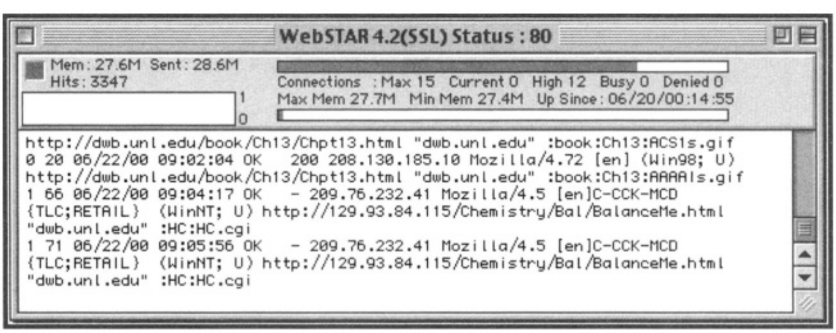


Figure 14.08. **Modified screen capture of Web server log window.**

## GLOSSARY

ANSI (American National Standards Institute): the organization for fostering the development of technology standards in the United States.

ASP (Active Server Page): an embedded server-side script used to serve interactive pages instead of using more traditional CGI programs. It includes a database-access component.

cookie: a small amount of text information that a server writes to your hard disk so that it can recall something later. Cookies often record preferences when using a particular site. The cookies that have been stored on a hard disk can be viewed in the latest implementations of *Communicator* and *Internet Explorer.*

ISO (International Organization for Standardization ): a federation of national standards bodies. Many countries have national standards organizations (like ANSI) that contribute to ISO standards setting.

## REFERENCES

Crippen, K. J., Brooks, D. W. & Abuloum, A. (2000). A Web-site supporting the AP descriptive chemistry question. *J. Chem. Educ, 76*, 1087-1088.

Hart, J. (1998). Got a database? ASPs take it to the Web. *Government Computer News, 17*(10), p. 33(1).

Orr, J. (2000). Personal communication. (Presented during seminar about *eGrade* (Chapter 15) at UNL, June 16.)

## URLs

U14.01. Water and solutions, http://129.93.84.115/Teacher/NSF/C01/C01.html, (accessed 4/2/00).
U14.02. ASP 101 – A Database Interfacing Primer, http://www.vallin.com/pub/1/aspl.asp (accessed 6/17/00).
U14.03. www.LearnASP.com by Charles Carroll, http://learnasp.com/ (accessed 8/14/00).
U14.04. US Census Bureau, http://www.census.gov/index.html (accessed 6/17/00).
U14.05. Yahoo! Maps, http://maps.yahoo.com/py/maps.py (accessed 4/2/00).
U14.06. Atomic Mass Adjustment, ftp://csnftp.in2p3.fr/AMDC/masstables/mass_exp.mas95 (accessed 4/2/00).

# CHAPTER 15

# Automated Testing

## MASTERY LEARNING

Of the research in learning, no strategies have led to better outcomes than mastery learning. In mastery learning, the learner is required to master material to a specified level before they can go forward. In *Human Characteristics and School Learning*, Bloom [1976] makes an excellent case for mastery learning.

Several school systems have attempted to implement mastery learning. There is substantial agreement about the success of mastery learning, particularly in college teaching settings [Kulik & Kulik, 1987; Kulik et al., 1990]. Many modern, structured learning programs include strong mastery learning components. In colleges, the most serious, systematic implementation of mastery learning was through so-called Keller Plans, also called personalized systems of instruction (PSI). These are named after Fred Keller, who formulated this approach to mastery learning [Keller, 1968]. Among the key elements to Keller's plan were self-pacing, repeatable testing, and peer tutors. These plans flourished during the decade around 1970. Kulik et al. [1979] {U15.01} reviewed this effort and provided an excellent summary of the evidence supporting Keller Plan instruction. In one review, they suggested that, "the future will bring even wider use of the plan." Keller Plan testing, however, drove both students and teachers nearly to the point of distraction. Silberman [1978] wrote an excellent summary of a teacher's view of Keller Plan impacts. He reported administering, grading, and filing 2500 five-question quizzes for 90 students in a sophomore organic chemistry class. Today, testing can be made available on demand. Much of this testing can be automated. Under these circumstances, it should be possible to implement modernized Keller Plan courses using technology that makes testing much easier for teachers, and more

accessible for students. Elements of the Keller Plan, especially repeatable testing, continue to find favor among college educators [Moore et al., 1975].

If you are interested in automated testing, you'll need more than casual computer support. The testing support available within courseware packages (Chapter 3) is still too limited to support mastery learning.

Mastery learning involves having students demonstrate mastery of material at a defined, high level before they proceed with flew material. Two essential elements of this instructional strategy are corrective, enriching feedback and congruence among the instructional components. In Keller Plan courses, quizzing is used for the corrective feedback. Mastery learning is reviewed in *Implementing Mastery Learning* [Guskey, 1996]. Bloom [1984] suggests that one-to-one tutoring is the most effective strategy known, generally yielding two standard deviations better performance than traditional instruction. Further, he suggests that mastery learning approaches one-to-one instruction in terms of measured learner gains. When students adopt self-regulatory strategies aimed at mastery learning, these have been associated with positive, achievement oriented activities [Elliot & Dweck, 1988]. Incorporating mastery systems into computer-based instruction has led to excellent learning outcomes [Montazemi & Wang, 1995]. When objective assessments are employed, prior knowledge is an exceptionally strong predictor of learning [Dochy et al., 1999].

Should students make their own decisions about monitoring their progress, or should control be retained by computerized testing? As noted in Chapter 11, Garbin finds that offering lots of information gives students with different styles the opportunity to learn in their own way. Penn & Nedeff [2000] describe a Web-based system for organic chemistry. They demonstrate higher earned test scores for those students making the largest number of attempts on Web-based practice system. Garhart & Hannafin [1986] report that students who control their own decisions about when to terminate instruction often do so prematurely.

## AUTOMATED TESTING

It has been possible to test students using computers for many years. With the advent of desktop computers, many teachers have developed testing programs of a wide variety. For the most part, when all other things are equal, computer tests give similar outcomes to conventional written tests [Zandvliet & Farragher, 1997]. The Graduate Record Examinations, produced by the Educational Testing Service, are given entirely online. Those tests now use a strategy that involves matching items to test takers such that fewer items are presented, but those presented are selected so as to maximize discrimination for the test taker. This strategy generally is called **computer adaptive testing**. If the student gets the first item correct, the next item will be harder. On the other hand, if the student misses the first item, the next item will be easier. This

approach is based upon **item response theory**, a remarkably powerful innovation in testing.

The concern that many faculty have about Web testing relates to ensuring who actually completes the test items. UNL has built a testing laboratory. Students can practice test over the Web. In many courses, however, they must come to the testing laboratory in order to take tests that count. Testing laboratories are becoming a part of the modern campus landscape.

In a graduate statistics course, Charles Ansorge has students identify a proctor who meets certain criteria. Distant students are then tested in the proctors presence. Ansorge's procedure includes having the proctor both sign on and sign off for the test. Faculty report using the strategy of phoning students during the test – but this has serious limitations. How do you handle calling into the one-line household in which the one line is connecting the student to the Web?

*Assessment and Evaluation of Distance Learners* was a PBS Teleconference (12/99), addressed this issue. There is tremendous interest in this area among educators. It often is discussed in journals that deal with online teaching [for example, see Carlson, 2000].

## EXAMPLE TESTING SYSTEMS

### eGrade

To accomplish automatic testing, one needs some powerful computer engines. John Orrs *eGrade* package {U15.02}, commercially available from John Wiley & Sons, makes use of Java programs written by Orr. This software runs on several platforms.

Orrs software is not restricted to any particular discipline; it is being used widely throughout the University of Nebraska–Lincoln campus. Orr responds to collegial suggestions and, as a result, the power of his system improves incrementally.

### Test Pilot

Another commercial package, developed at Purdue University, is *Test Pilot* by ClearLearning {U15.03}. *Test Pilot* also is authored in the Java language. Faculty at UNL also have very satisfactory experience with *Test Pilot* software.

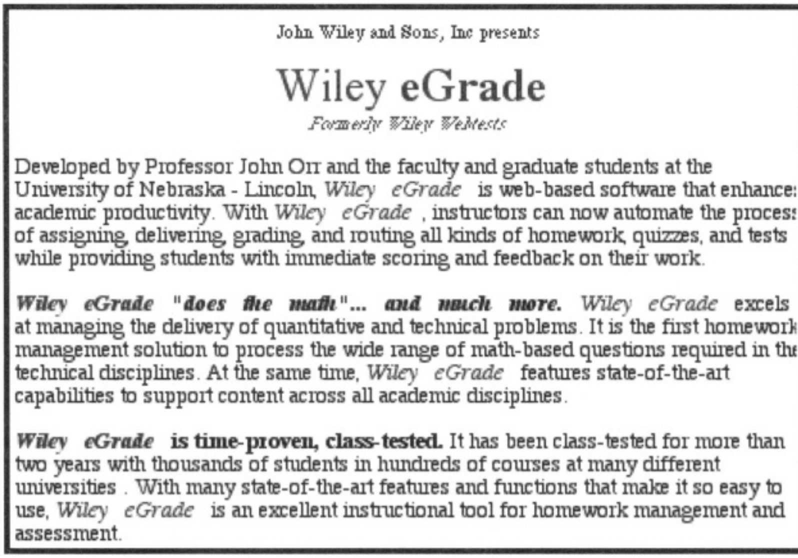


Figure 15.01. Web-based testing software developed by John Orr and distributed by John Wiley & Sons, is a powerful Web-based testing tool. This material is used by permission of John Wiley & Sons, Inc.

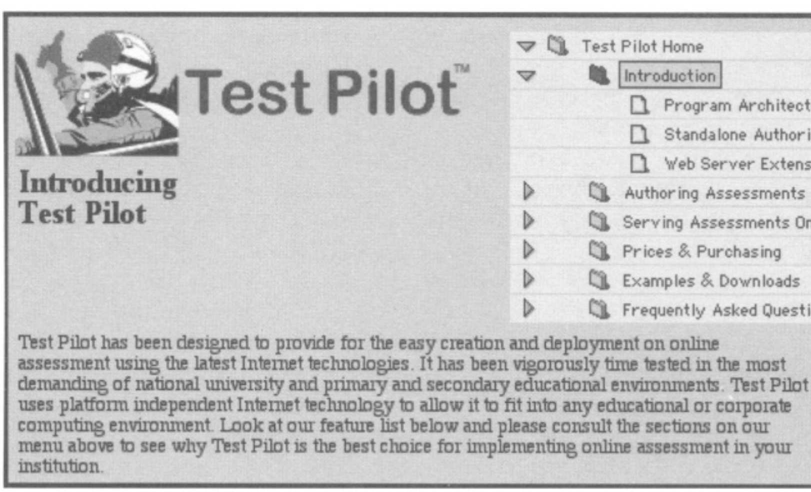


Figure 15.02. *Test Pilot*, a Java-based, platform-independent, Web-server based, online assessment and survey software. With permission.

## Chemistry Tests

We have done research on automatic testing on the Web. This research is less concerned with traditional testing for assigning grades to students, and more with mastery learning by practice. The testing is designed to keep learners working on a question topic until they "get it right." The questions are generated by the computer, as opposed to pulling them from a bank of questions. The items have great variety. The information is stored in a database, and the questions are generated with encrypted codes. Students respond to quiz items that may be presented in any of ten formats. Upon receipt, the feedback provided to a student's response is not only context-related, but it may be shaped by features in the student's response. In a few cases, responses are checked for common misconceptions, and tutoring to address those misconceptions is provided in the feedback.

The normal boiling point of benzene is 80.2°C and the heat of vaporization is 30.8 kJ/mol. Calculate the vapor pressure in atmospheres at 43.0 °C.

You did not make a response.

Accepted solution:
vapor pressure = 0.291 atm

Use 1.00 atm for the normal boiling point pressure. Use the Clausius-Clapeyron equation to calculate the vapor pressure at temperature given. R = 8.31452 J/K-Mol. Remember to change temperatures to Kelvin.

Exp({1000*30.8/8.31452}*{(1/(273.1+80.2)) -(1/(273.1+43.0))})

The answer must be a number.

Credit **NOT** awarded.

---

This page created by computation at 10:32:19 AM on Wednesday, March 15, 2000.

Figure 15.03. **Response to an item for which the respondent sent in a blank answer.**

The verification strategy to ensure academic integrity is to sample small portions of the required material after students have completed the entire package. If the small sample indicates that successful learning has occurred, the assumption is the student has learned all of the material as well.

## ADMINISTERING TESTS

Although Web-based testing is possible at remote sites, many faculty want to administer proctored tests. UNL has established a testing laboratory. In this laboratory, students are proctored while they take tests. The testing student sits at a terminal, indicates the test to be taken, and logs in to the test. A proctor then verifies identity using the student's photo ID. Upon identification of the testing student, the proctor completes the log-in procedure. At the end of the test, a proctor logs the student out before the test grade and full results are made available. The laboratory shown in Figure 15.04 is being expanded to include about 60 stations.

Figure 15.04. **Testing lab for administering Web-based tests at UNL.**

## GLOSSARY

computer adaptive testing: the test-taker's ability level relative to a norm group is estimated iteratively during the testing process. Items are selected based on the current ability estimate. The procedure is thought to maximize the information about the test-taker's ability level. Test-takers receive few items that seem very easy or very hard. Testing ceases at a given level that is the test-taker's highest sustainable performance.

item response theory (IRT): was developed to overcome shortcomings in the "true score" testing model wherein learners were assigned a score on a test, and that score represents the persons true ability. IRT looks at items, and expects persons of similar ability to perform similarly on an item. In this terminology, a test is unbiased when all testers having the same skill level have an equal probability of getting the item correct. If persons of similar

ability but different gender perform differently on the item, then the item is said to be biased.

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# CHAPTER 16

# Advanced Interactivity

The automated testing described in the previous chapter brings the interactivity described in Chapter 7 to a high point. You can expect the Web to support still higher levels of interactivity. The purpose of this chapter is to help you to envision broadly what is likely to develop on both the client and server sides of the Web within the decade.

## EVALUATING STUDENT WRITING

For most teachers, when some student-created composition is to be evaluated, it will either be brought into a courseware program or shipped off by e-mail for a human evaluator to read, comment upon, and score. There are at least two approaches for transferring the responsibility for the evaluation of student writing from the teacher (or a reading assistant) elsewhere.

### Peer Evaluation

Developed by Orville Chapman of UCLA, Calibrated Peer Review™ is a scheme that permits evaluation of writing by students in classes.

> Calibrated Peer Review (CPR)™ is a program, for networked computers, that enables frequent writing assignments without any increase in instructor work. In fact, CPR can reduce the time an instructor now spends reading and assessing student writing. CPR offers instructors the choice of creating their own writing assignments or using the rapidly expanding assignment library. Although CPR stems from a science-based model, CPR has the exciting feature that it is discipline independent and level independent. When young children first begin to write a paragraph, they can use CPR

> profitably, and yet the same program serves college and university students as well as graduate and professional students.
>
> Calibrated Peer Review {U16.01}

### Automatic Evaluation

Substantial progress has been made in the automatic evaluation of text [McCollum, 1998]. Peer review requires that several peer students be available. It is a batch mode approach. By contrast, an entirely computer-based strategy for text evaluation is called latent semantic analysis [Landauer & Dumais, 1997]. The outcomes of this and similar studies are quite remarkable; the rules computers generate for themselves at this task seem so different from the ones we might want to invent for them to use. A Web site for researchers {U16.02} deals with latent semantic analysis {U16.03} strategies. It is likely that at some Web-based grading of texts will appear in the near future.

It is clear that students are finding, or even purchasing, materials on the Web and submitting them as their own. Several companies offer services for teachers that use sophisticated search techniques to help detect Web-based plagiarism. This issue will be discussed further in Chapter 19.

## APPLICATION SOFTWARE RECENTRALIZED

Computer users schooled in the 1960s are likely to recall highly centralized computer centers on school campuses where many things important to successful computer use were controlled by others. Desktop computing, with each machine having its very own copy of software programs, was a powerful, liberating force.

Many software development companies now provide software over the Web. In the age of the Web, software can be downloaded directly to our machines. Use of the Web as a software delivery system for commercial software is widely accepted.

The next step is likely to be a recentralization. Much software will reside on large servers to be doled out to users on an as needed basis. As with so many such matters, no vote will be taken. If this proves to be economically viable, then it will happen – almost certainly to the detriment of current desktop software quality and access.

So, looking down the road just a few years, we can expect educational software licenses to be very different from what they are today. The letters “asp,” once thought to describe a poisonous snake used to bring Cleopatra to her end, have several new meanings in the 21st century. One is active server pages {U16.04}, a scheme developed by Microsoft to handle data returned from Web forms. Another is application service providers {U16.05}, those folks who may succeed in recentralizing computer software.

The 25-year migration of computer software from the mainframe to the desktop has included the development of some remarkable packages. As a reader, you almost certainly have access to a desktop computer, and to software such as a word processor, a browser, an e-mailer, and more. This same time period has seen some very powerful advances, especially as graphical representations became easier to accomplish. The notion of application service providers, of course, is that they will lease software licenses for brief periods of time. End users will pay for what they use rather than buy an expensive program that may experience little usage. There probably is an undercurrent of thinking that software piracy (now estimated at about 50%) will decrease {U16.06}.

## Mathematics

*Mathematica,*{U16.07} first developed as a mathematician's tool, has evolved through several generations. In 1999, David Fowler, a UNL colleague, taught an Internet-based course centered on *Mathematica.*

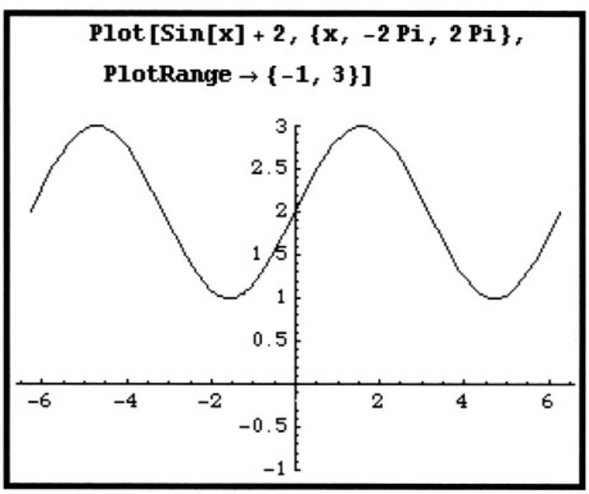


Figure 16.01. **Screen capture from Web materials produced using *Mathematica*.**

*Mathematica* is precisely the kind of program that we might expect to see migrate from the desktop back to a server. It is relatively expensive for individual purchase, even to purchase a "student" version. Instead of buying licenses for individual copies, users can expect to pay for the total amount of use. This meets well the needs of infrequent users, trainers, and others for whom daily or weekly access to the software is unnecessary.

## Chemistry

CambridgeSoft Corporation {U16.08} is one of several companies that have developed software for organic and other chemists. Beginning with programs that drew organic structures, these have blossomed. Prior to their inception, creating structures for publication was a very time consuming task involving ink drawing tools, transfer letters, and much tedium. A remarkable change took place when ChemInnovation {U16.09} introduced software that, given the chemical name of a molecule, would produce the corresponding 2-D structure (Figure 16.02). More recent software allows limited manipulation of the structure as a 3-D representation. Programs are also available that predict spectra of all sorts, including numerous technical features. Software can even facilitate making a Web-based purchase of commercially available chemicals.

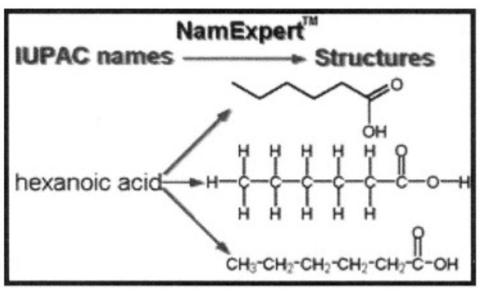


**Figure 16.02. Software can create 2-D representation of a chemical formula from its name. Three styles of 2-D formulas are shown. The same information can produce 3-D movable representations. With permission.**

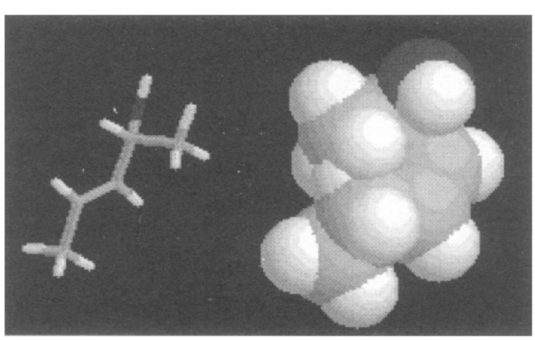

**Figure 16.03. Today one can go from a name to a manipulable 3-D structure, one that can be incorporated into Web materials.**

## SELECTED MULTIMEDIA PROGRAMS

For some time, it seemed as if every hypermedia program (*HyperCard, ToolBook, SuperCard*) would have some equivalent version running on the Web. Much of what one would like to accomplish on the Web with a hypermedia program is better handled using either Web technology or some other approach.

### Macromedia *Director/ShockWave*

*Director* is a program well suited for multimedia interaction. It may be the program of choice for developers with large graphics budgets. *Director* already is a cross-platform product, with Mac and Windows versions available.

Macromedia {16.10} developed a "plug-in" called *ShockWave* to enable playback of multimedia materials on the Web. Materials developed in *Director* played with *ShockWave* promise to play a very important role in Web interactive materials.

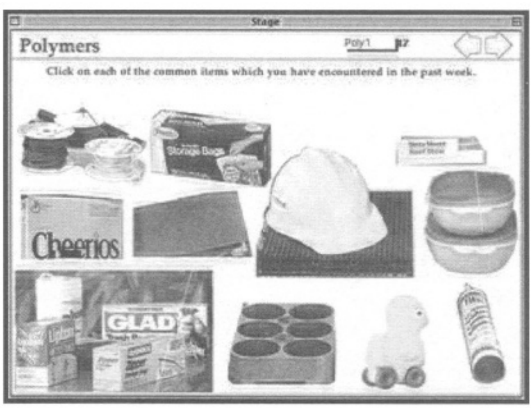


**Figure 16.04. Macromedia *Director* "Stage." These images are part of a simulation for students considering careers as chemistry laboratory technicians.**

*ShockWave* will stream information to the browser, buffering information until sufficient information is on hand to allow it to be played smoothly. Figure 16.04 is a screen capture of the development of a *Director* program by Helen Brooks (Synaps Chem Tools). John Markwell's electron transfer (see Figure 8.13) was created using *Director* and then converted into a *ShockWave* file for Web delivery.

### *Flash*

*Flash* {U16.11} by Macromedia is one of the most exciting developments in the area of advanced interactivity. Using *Flash,* a Web learning environment can contain highly interactive programs of the sort previously made possible by *HyperCard*, *SuperCard*, *ToolBook*, and *AuthorWare*. *Flash* features include musical tracks, sound effects, animations, and innovative interfaces. The graphics created in *Flash* appear smooth on screen (anti-aliased). Because *Flash* files are vector-based rather than pixel-based (that is, more like a drawing program than a painting program), they download quickly.

As an example of the kind of interactivity supported by *Flash,* visit the Furniture.com Web site {U16.12}, and construct a plan for furnishing a room in your residence. The power of this Web tool is really quite remarkable.

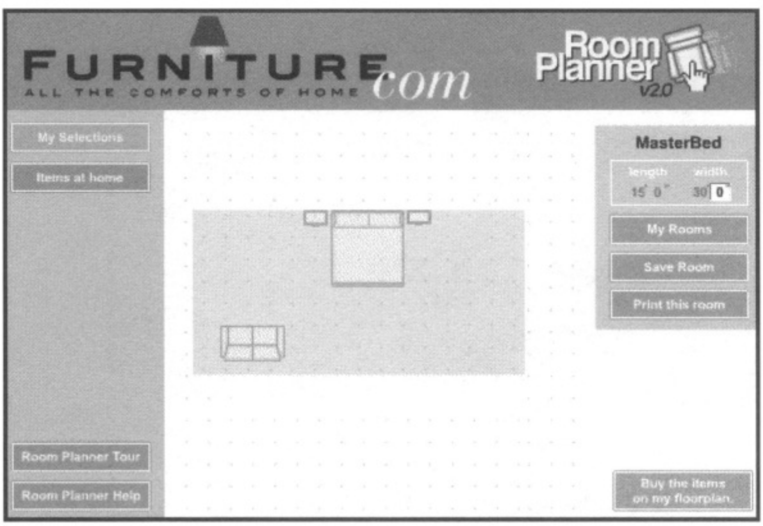


Figure 16.05. **Screen capture of a very simple, personalized room floor plan with four pieces of furniture in a large room. Furniture.com saves individualized floor plans. With permission.**

Can you imagine having your students create some individual project, and then sending you information so that you access what they have created? The processes are similar to or the same as those used by Furniture.com. To create instructional materials at this level, you need either deep technical skills yourself, or access to some highly skilled assistants.

## CLIENT-SIDE INTERACTIVITY

When the Web first emerged, browsers were quite limited. Shortly, movies and animations began to appear, and these brought screens to life – even if they did not provide interactivity. The tools used to display molecular models have made an impact on chemistry education. Clickable maps have impacted Web teaching, especially. Nevertheless, more interactivity than clicking is desirable, and that interactivity should be at the client side when possible.

### JavaScript

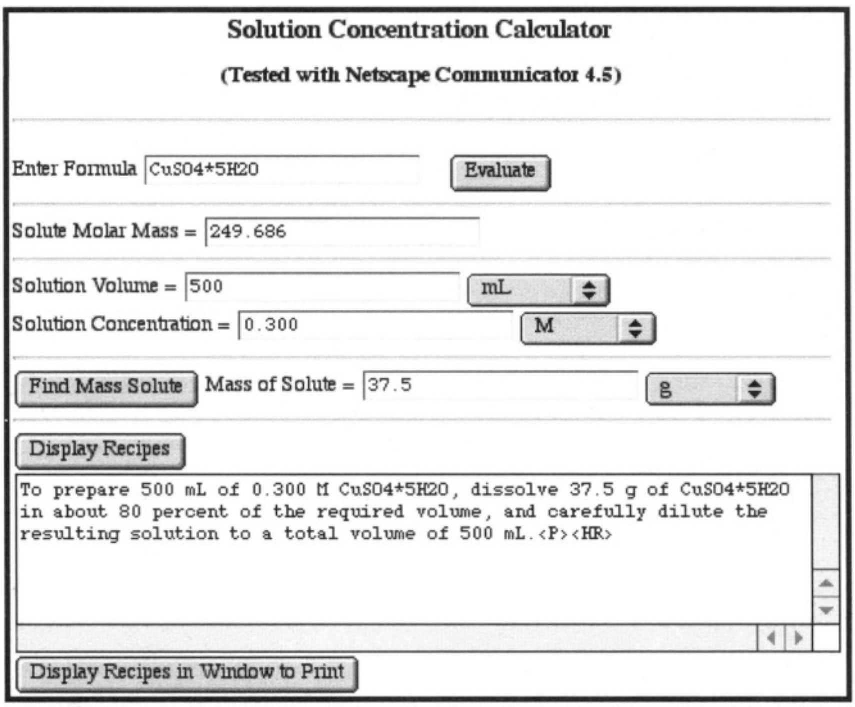


**Figure 16.06. Screen capture of Web page used to assist chemistry teachers when preparing chemical solutions.**

The idea is to ship some intelligence along with the encoded HTML files when possible. Scripting languages (programming languages) were envisioned early on. Livescript {U16.13}, the language initiated by Netscape, was soon renamed JavaScript. Java and JavaScript often are confused; they are distinctly different entities.

Using JavaScript, we developed a Web page to help chemistry teachers make the calculations needed to prepare chemical solutions {U16.14}. The user enters a formula and clicks the "Evaluate" button. The JavaScript program parses the chemical information stored in the formula, interprets it in terms of the atomic masses of the atoms involved, and calculates a molar mass for the formula. The user then enters the volume and concentration of the desired solution, and clicks the "Find Mass Solute" button. The JavaScript program determines the mass of materials to be weighed. By clicking the "Display Recipes" button, a procedure for making the solution is obtained. The Web page includes HTML programming that enables the teacher to produce a Web page with the calculated recipes. The page may be printed for later use.

## SERVER-SIDE INTERACTIVITY

Scripting works within Web pages on the client machine. Sometimes teachers need more powerful tools, ones that either extend or go significantly beyond the confines of the browser environment. This requires serious programming.

### Java

Java {U16.15} is a computer programming language and a platform invented with the Web and Internet in mind. When programs are created, selecting a programming language always is an issue. Java seems to be increasing in its importance.

The creation of interactive instructional materials often requires programming. One way to program is to learn how to do this yourself. Another is to hire student or professional programmers. Neither approach is without difficulties. Unless you've been trained and practiced as a programmer, you may never get to be very good at it, and the time required for you to accomplish minimal work may be very long – detracting from your other professional duties. If you hire out programming, be certain to spend a great deal of time browsing sites that are interactive and bookmarking URLs. Sometimes having examples to use is exactly what you'll need to make your programmers aware of what you want.

Java is capable of supporting full-blown applications. Perhaps of more interest to teachers is its use in creating applets, mini-applications that depend upon the browser and can be inserted into Web pages. Applets are served out to the client; they usually do not need to interact with the server in order to accomplish their tasks.

William Glider and his colleagues [Horn et al., 1997] have developed a supplementary Web site with many features including several Java-based

tutorials. For example, one Java applet permits drag and drop of labels into concept maps. According to its designer, this applet can keep track of student moves, and thereby generate useful research information about student learning.

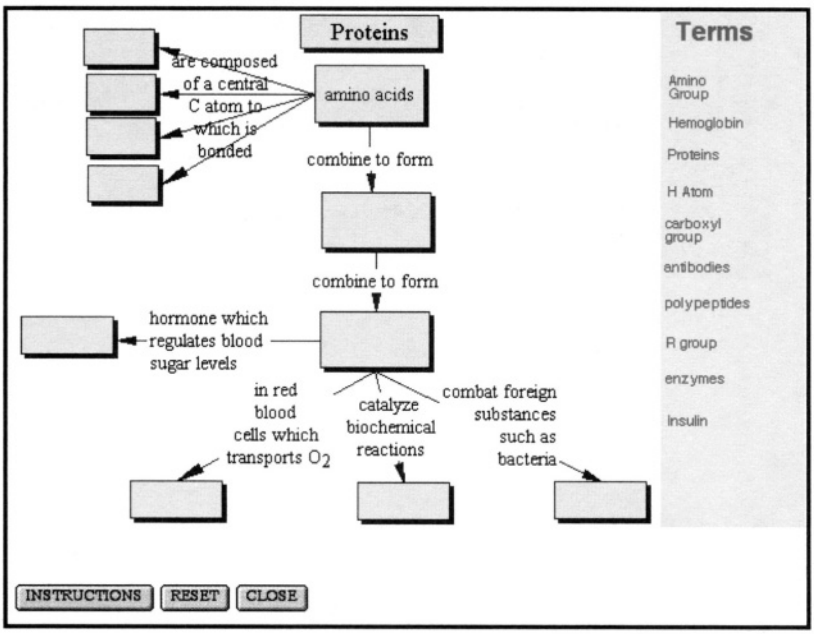


**Figure 16.07. A Java applet tutorial in which students drag labels into concept maps.**

Several very interesting Java applets have been developed for use in physics {U16.16} by the Kiselevs. For example, one illustrates the convergent lens. The user can move the object on one side of the lens, and see how the image will appear on the other side (Figure 16.08).

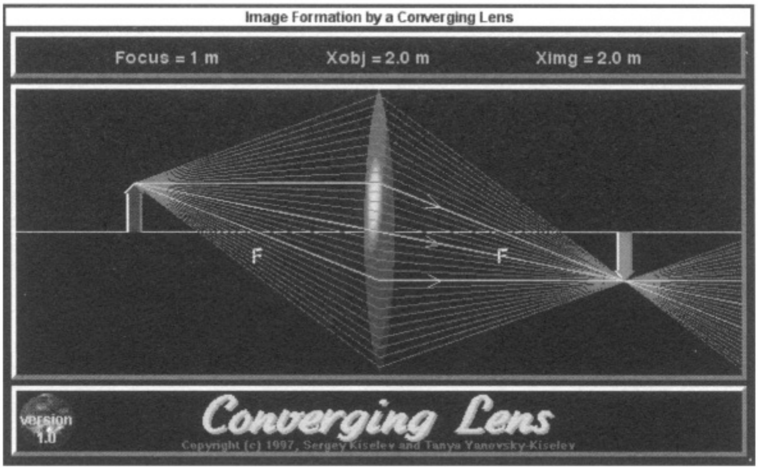


Figure 16.08. **Illustration of a Java applet that allows students to perform simulated experiments with a converging lens. With permission of the applet author.**

## CGIs

**The Common Gateway Interface (CGI)** is a useful tool. Whether you're the lone maintainer of a single home page on someone else's machine or the Webmaster of a huge domain, CGI is an important tool for supporting interactivity. Much of this interactivity is related to databases (Chapter 14).

In a CGI system, information from a clickable map or form is sent from the client to the server for processing. There are many ways to accomplish this interaction. One method is to use *HyperCard.* HyperTalk, the *HyperCard* programming language, can be used to create useful Web applications quickly. Several of the examples in Chapter 15 are based upon *HyperCard* CGIs. *HyperCard* is only available on the Macintosh platform. CGIs often are written in the scripting language **Perl.**

Writing CGIs is nontrivial. A talented student who knows some programming may be able search the Web for CGI freeware and adapt something for the task. A student still wiser in the ways of bits and bytes can create CGI applications from scratch. If such students are not available, find a professional programmer.

As time goes on, the process of creating CGIs will be made simpler and simpler. Server software will continue to be enhanced to facilitate using CGIs. Authoring tools will emerge that will ease the process of creating CGIs. Creating CGIs may never become very simple, however, except for the creation of look-alike sites that adhere closely to specific templates.

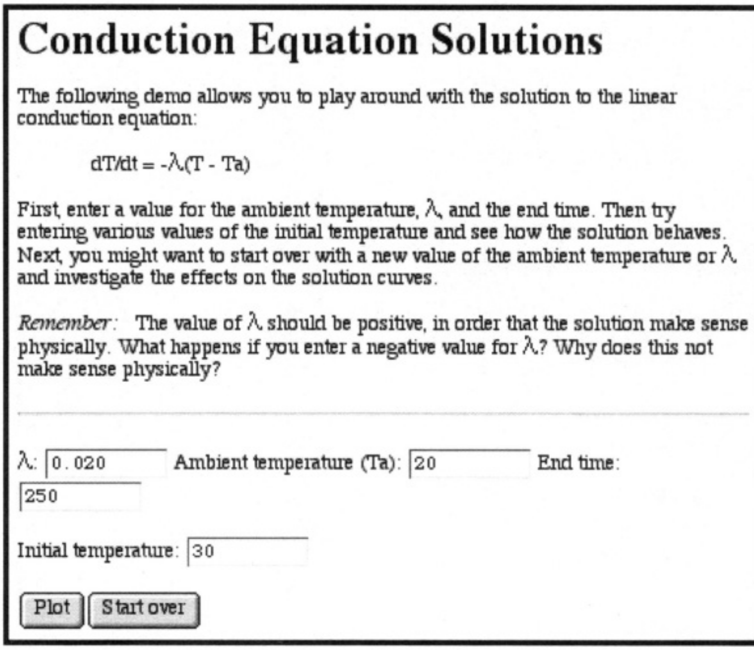


**Figure 16.09. Page for entering values in cooling equation.**

One example of CGI is a Web site that uses Perl CGI programming {U16.17} to illustrate the phenomenon of cooling. The user enters initial and ambient temperatures, and a coefficient that describes cooling. The CGI calculates the cooling and plots the result graphically as an image on the Web page (Figures 16.09 and 16.10).

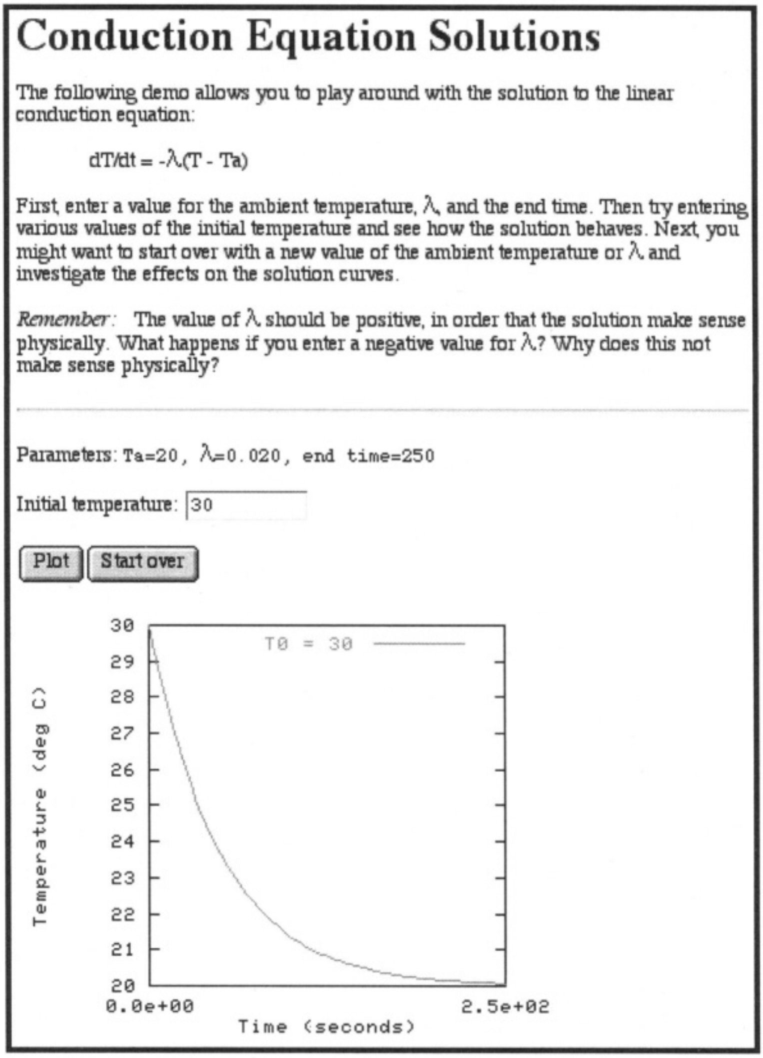


Figure 16.10. **Calculated cooling curve created by CGI program.**

## NEW WAYS TO ENVISION CURRICULA

It is not difficult to imagine creating sophisticated questioning strategies for presentation on the client side as a result of programming. When the techniques described here and in Chapters 14 and 15 are considered holistically, it becomes

quite clear that a new dawn in education is emerging. It is possible to project highly interactive instruction world wide, and to provide active learning environments which, as suggested in Chapter 2, promote deep understandings of conceptually-rich content.

The next edition of this book is likely to have a chapter devoted to the automatic interpretation of written text. Current work is focusing on Web-based discussion groups so that we can expect the emergence of new ways for teachers to structure Web-based conversations between students rolling in and out of learning environments – and not organized into units of classes and courses.

Nevertheless, as smart as these machines get, we suspect that none will replace teachers. The roles of teachers and the realities of teaching are likely to change considerably, however, from what they are today.

## GLOSSARY

CGI (Common gateway interface): the connection between the browser and server that runs a program. CGI programs can set and read small amounts of text on the client machine (called cookies), get and tabulate browser and operating system information, and so forth. By using CGI rather than browser-based scripting, nearly all users will be able to make full use of your pages. CGI scripts usually are not limited by browser or firewall limitations.

Perl: a high-level programming language with process, file, and text manipulation facilities that make it particularly well-suited for CGI script authoring.

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U16.07. *Mathematica,* http://www.wolfram.com/ (accessed 4/3/00).
U16.08. CambridgeSoft Company, http://www.camsoft.com/ (accessed 4/3/00).
U16.09. ChemInnovation, http://www.cheminnovation.com/ (accessed 4/3/00).
U16.10. Macromedia, http://www.macromedia.com/ (accessed 4/3/00).
U16.11. Macromedia Flash, http://www.macromedia.com/software/flash/ (accessed 4/3/00).
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# CHAPTER 17

# Weblets, CD-ROMs, Intranets

## WEBLETS

A **weblet** is a self-contained, hypertextual, multimedia resource isolated on a hard drive, CD-ROM, or similar storage system. There are three reasons to impose control by creating a weblet: to speed access, to control access, and to ensure availability.

When students access your materials from home or off-campus, they are at the mercy of Web traffic. Web traffic sometimes can become a problem during busy periods. A weblet can run as fast as your local network or drives permit. When you click a link, you are connected to another file on your network, and not somewhere out on the Web.

On the Web, students can surf wherever they please. In schools and on campuses, especially in precollege settings, you may prefer to control student access to the Web. Because a weblet is self-contained, students cannot get into objectionable material. This is a big issue with many parents, and is therefore of real importance in precollege settings.

The good news about the Web is that it is dynamic. A search performed today may give very different results than one performed yesterday, or one that will be performed tomorrow. The bad news about the Web is that is dynamic. The teacher who plans tomorrow's lesson on today's Web findings may be out of luck. The constantly changing, dynamic nature of the Web is one other reason to consider building and using a weblet. Teachers invest significant amounts of time in creating instructional materials for their classes. Most plan on using the materials more than once, and during subsequent academic years. Linking to excellent resources on the Web is an efficient use of existing resources, but in doing so the instructor is committed to maintaining these links for as long as they use the instructional materials. The Web is not like a traditional library;

there is no "Web archive," and there is no guarantee that the really great Web site you link to today and build course activities around will be available anywhere on the Web tomorrow.

The issues of speed, access, and the nonarchival nature of the materials used might start a teacher thinking about constructing and using a weblet for instruction. Remember, however, that what you are doing in creating a weblet is removing the most powerful feature of the Web, namely, world-wide connectivity. Creating a weblet for instruction might also require a large amount of storage space. You might consider using CD-ROMs for this purpose in addition to local hard drives or server storage.

## CD-ROMs

A CD-ROM began as a read-only storage medium with a large capacity. Today ROMs can hold 640 megabytes. Soon this capacity is expected to increase by a factor of ten or more. Rewritable CDs and the drives to create them are becoming ever more affordable. Currently, laptop devices often offer rewritable CD-ROM drives as an option.

CD-ROMs can be constructed with data accessible to both principal desktop computing worlds, Windows and Macintosh.

It's getting so that buying a computer without a built-in CD-ROM drive is becoming more and more difficult. Floppy drives, the meat and potatoes storage devices of a decade ago, are slowly becoming extinct. Software manufacturers use ROMs as a low-cost means for distributing software. CDs have fewer defects; more information of a peripheral nature can be provided at low cost; electronic manuals are commonplace, with printing costs transferred to the end user; and nearly all production costs go down. Teachers might well begin thinking about providing course materials for students on CD-ROMs. Making CD-ROMs one at a time has become both easy and inexpensive. The first CD-ROMs we burned cost $45 for the media. Today, $2 each is an upper-limit price for blank ROMs.

The CD-ROM, even for 50-100 students, is becoming an attractive alternative. As we noted earlier, our colleague Charles Ansorge provides CD-ROMs as an alternative to streaming video. The video quality on the ROM is noticeably higher than that of streaming video in nearly all cases. The principal reason for offering the CD-ROM is that download times to modem-based machines are reduced enormously.

Weblets of course materials can also be built on a "removable" drive medium instead of the permanent CD-ROM. Material is stored in a controlled area with the tools for copying. Students bring blank disks to this resource center and copy the materials on a Zip, Jaz, or similar medium.

## Obtaining Web Materials

The law about using Web materials created by others is evolving. Publishing on the Web seems to put everything up for grabs – including those materials you've created at great personal expense.

What about Web materials created by others that you want your students to access? Providing links to those materials or referencing them in some other way is generally acceptable. Capturing copies of those materials and incorporating them into a weblet has legal ramifications. Always request permission before you copy. If the material has a copyright statement, ask the copyright owner. If not, ask the Webmaster of the site. If you are creating a weblet, you'll need to decide how much "foreign" information you want to include, and then decide how you are going to go about obtaining that information with appropriate permissions.

*WebWhacker* and *Web Grabber* are programs that permit users to go to a site and copy much that is there. These are remarkable software packages not only in terms of what they accomplish but also in terms of the acceptance of that process. Creating weblets preserves your authoring rights in conventionally protected formats. After all, would you permit strangers to come into your offices at all hours to make photocopies of your paper files? Additional discussion of legal issues appears in Chapter 19.

## Making CD-ROMs

To make weblets you need something like a removable hard drive (e.g., optical, Zip, Jaz, Syquest) or a ROM maker.

Old CD-ROM drives limited throughput to something in the neighborhood of 125 kilobytes per second. In the world of video information, this rate is quite slow. At this writing, the marketplace is flooded with faster drives with speeds more than ten times the early ROMs.

*Toast Pro* software makes formatting of the ROM straightforward. Many companies, such as APS, sell hardware to make single ROMs (Figure 17.01).

The investment by a school, department, or college in a ROM duplicator is reasonable if ROMs are used often and class sizes are small. However, for large classes (>50) you probably will do better by creating one master and having a commercial company reproduce your ROMs. When really large numbers are involved, the price of duplicated ROMs currently drops to about $0.50 each. (That's why software manufacturers love ROMs as a distribution medium! In large production runs, ROMs are stamped using glass. The cost of producing a glass master is high, but, when it is used thousands of times, it is recouped.) Disc manufacturers will compete for your business. The size of the production run determines costs. When just a few ROMs are involved, a mechanism of

making several "one-offs" with the assistance of student workers on a fast ROM writing drive makes sense.

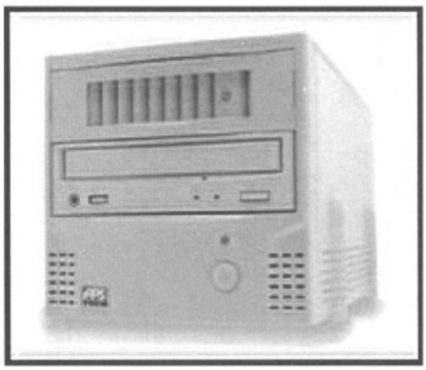

Figure 17.01. APS 9GB/CD-RW 8x4x24 {U17.01}. The reason to use a system that incorporates a hard drive with the ROM burner is to get precisely the arrangement (sequence) of contiguous files desired on the drive leading to the most efficient possible ROM. The failure rate is high enough that ROMs should be verified after burning.

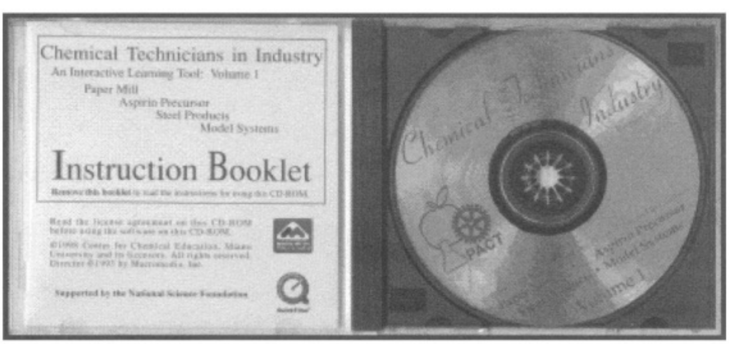


Figure 17.02. CD-ROM developed to simulate the work of chemistry technicians in industrial settings, from Synaps Chem Tools. CD-ROMs are manufactured by a stamping process from a master.

Getting the material ready to make the ROM can be both expensive and time consuming. The more material you have, the more costly the process can

be. You need to keep this in mind – who pays for that time? If what you want to do is get 300 pages of material into your students' hands, ROMs start becoming attractive in terms of cost to students. As soon as you break into media such as movies, animations, and sounds, then ROMs become very attractive. Students may want and sometimes need print copies. When the instructor provides a CD-ROM, the task and costs of creating the print copy are transferred to the student. If text materials are provided in the .pdf format, excellent quality printing becomes possible for students.

Students appear to like printed material almost regardless of the cost. In 1980, when students were provided with microfiche copies of old exams they used the microfiche, but also made many print copies. Most students were happy to have so much old exam material, but felt the need to have some in print. At the time, copying from a microfiche was twice as expensive as ordinary paper copying. As more and more colleges require that students obtain personal computing devices, expect to see an increased use of CD-ROMs.

CD-ROMs afford a physical object in possession, a comforting mechanism for dealing with copyright issues. Objects such as books and magazines are in tune with our publishing past. Because CD-ROMs can be used off-line, they afford a solution to the access/bandwidth problem often encountered by teachers using the Web. Also, there is a sense of archival documentation in the use of a ROM. Unlike materials found on the Web, ROM materials will not vanish into hyperspace.

Copyright issues must be carefully handled. Copyright on the Web is a difficult issue, and seems to become cloudier over time. Using a CD-ROM provides hard copy that can stand as verification of good copyright practices.

When using a ROM, use file references instead of http: calls. An appropriate HTML file is shown in Figure 17.03.

```
<HTML>
<HEAD>
<TITLE>Test</TITLE>
</HEAD>
<BODY>
Show <A HREF="file:///MacintoshHD/BalloonHelp.mov">movie</A>.
</BODY>
</HTML>
```

**Figure 17.03. HTML file indicating ways to reference files for browser such as movies or sounds from an accompanying CD-ROM. This avoids the problem of having the browser duplicate a copy of the file in its cache. If you write the code this way, the browser uses your ROM as if it is a hard drive rather than as if it is a server somewhere on the Web. When your browser reads files from a local drive, they are not copied to the browser's cache.**

## INTRANETS

An **intranet** is a "private" network that is contained within an organization such as a university or school district. It usually includes connections through one or more gateway computers to the Internet through **firewalls** – security systems designed to control all sorts of activity. The main purpose of an intranet is to share school information and computing resources among faculty, students, and staff, or to share corporate information between employees. An intranet uses the same protocols and methods as does the Internet: TCP/IP, http, and so forth. The part of an intranet that is made public sometimes is called an extranet.

Standing at a distance from an intranet, it looks like everything else on the Internet. Snipping just one or two connections, however, usually will leave it isolated. If a school were to provide computers with modems, then each modem would represent a potential leak from the intranet. Information could be moved through individual computers and telephone-based Internet service providers to the outside world.

An intranet uses the very same software as is used on the Web. It gives all of your students, faculty, employees, and customers the same flexibility that Web users have in terms of platforms and software.

> Companies are turning Web technology loose on private LANs, and the resulting intranets are disseminating vital information as well as enabling users to tap into databases and simple groupware features. Intranets are also helping IS managers solve an old problem: distributing company data to multiplatform users.
>
> Streeter, 1996b

Several Web sites including *The Complete Intranet Resource* {17.02}, *Intranet Digest* {17.03}, and *Intranet Design Magazine* {17.04} are devoted to intranet issues.

Application access may be the most important intranet feature. The creation of the desktop PC has led to software decentralization. Older users trained in a different era are especially fond of the freedom from a central data processing center afforded by software decentralization to the desktop. The notion of recentralization of software with users accessing servers is a very interesting and important one, since it implies return of control to a central organization. Many companies prefer this control for other reasons. One reason is to deter use of illegally copied software on company networks and hardware.

Schools can use intranets to deliver instruction. Every computing device on a TCP/IP network gets a unique IP address. Using these numbers, it is possible to control access to a server – to exclude those communicating from a computer with an unacceptable IP address. A school can, therefore, exclude outside users from its instructional resources.

Several K-12 schools in Nebraska have created intranets. Lincoln Public Schools in Lincoln, Nebraska has a remarkable intranet structure. From the administrative offices, it is possible to look at the same screen that any teacher or student in the system is looking at! This is especially effective for troubleshooting. It also affords a high degree of control.

Because intranets control access, commercial providers can offer fee-based instruction services to schools systems. *Jostens' Worldware* {U17.05} provides such services, for example. Chancery software {U17.06} has very ambitious efforts along the lines of providing access to instructional content as well as management services (grades, attendance, etc.).

### Security-Privacy

Unfortunately, teachers must be concerned with some security and privacy issues related to students. College instructors that work with K-12 schools, as well as K-12 instructors, should consider the use of intranets to limit access to student works or images on the Web. Many K-12 school districts have established policies regarding the electronic publishing of student information or images. An intranet makes it possible for instructors to publish student material while restricting world access. Publishing K-12 student information or images should be carefully thought through before any type of online projects or exchanges are conducted. An innocent act of publishing a student's image with their name next to their work potentially can have severe consequences. Since the policies regarding Web publishing and K-12 students vary greatly in school districts, it is important to check your local policy in advance of conducting any projects or exchanges.

Keypals {U17.07}, for example, offers many sites where students might find Web-based pen pals. Many teachers have experimented with using the Internet to e-mail exchanges between their students and students in other places around the world. However, there is really no way of knowing exactly who is at the other end of an e-mail address. Students might exchange messages as an entire class rather than private messages between students. Teachers can set up e-mail exchanges with teachers they already know in other locations rather than just connecting to a Web site and sending messages to virtual strangers. In the case of K-12 students, there is an extremely strong need to use great caution with respect to Internet access and e-mail exchange.

## GLOSSARY

firewall: allows limited access to your site from the Internet. "Approved" traffic can move in and out according to a plan. You select the services necessary for your teaching, but bar others.

intranet: a private network that is contained within an organization such as a university or school district. It usually includes connections through one or more gateway computers to the Internet through firewalls – security systems designed to control all sorts of activity. The main purpose of a school intranet is to share school information and computing resources among faculty, students, and staff. An intranet uses the same protocols and methods as does the Internet: TCP/IP, http, etc.

weblet: a complete, self-contained subset of hypertext linked materials available from a single source other than the Internet. Weblets are constructed by persons for whom access must be assured, and for whom the full power of the Web is not essential. While weblets provide access and security, they defeat one of the Web's main objectives, namely, unrestricted, worldwide hypertext linkage.

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# CHAPTER 18

# Security Issues

This chapter concerns security. The Web is published everywhere. Maybe world wide distribution is not best suited for you!

> In the heterogeneous, hacker-happy world of the Internet, network managers can never be entirely sure of the safety of their networks. While Macs have decided security advantages compared to Unix-based Internet hosts, even pure-Mac sites should have operators who know the latest options for putting LAN resources under lock and key.
>
> In a survey last year of more than 300 IS professionals and their network sites, the Computer Security Institute of San Francisco found that about 20 percent of organizations with an Internet connection admitted to suffering a "security incident."
>
> Ironically, the Mac is less vulnerable (and therefore more appealing) because of the proprietary, closed operating system and hardware that hindered its popularity in the general business market. Unix is still king of Internet server platforms, and Microsoft Windows NT plays the great contender, but the Mac has found a comfortable middle ground as a popular platform for the Web and Internet services.
>
> Streeter, 1996, p. 33

This quote appeared in the first edition of *Web-Teaching*. We began reworking this chapter during the week of February 6, 2000. During that week, "unknown persons" alternatively described as hackers attacked several popular commercial Web sites. Although the attacks did no lasting damage, their actions created what is described as a denial of service {U18.01}. Voluminous requests were directed toward the target sites during a very brief time (seconds). As a result, access to the sites by regular customers became either very slow or nonexistent. From the outset, knowledgeable persons recognized that the Web

was subject to such problems, and that the battle between hackers and the worldwide commercial establishment would continue far into the future.

## PROTECTING THE WEB SITE

Your server needs protection – from power interruptions, on-site intruders, and Internet-based intruders. One standard admonition always seems to apply: back up; back up; back up; and then, don’t forget to back up the material at the site. Don’t forget to back up the material on a second computer; or even at a second site. If you are running your own server, keep it under lock and key in a controlled access area. You have the same things to fear from permitting access to your server as you would have permitting access to your desktop computer, to your records, to your exams, and to your laboratories.

### Crashes

As noted in Chapter 10, it is necessary to deal with computer crashes. Crashes are an unavoidable problem; they happen. The key is to discover and recover. As mentioned earlier, devices such as Rebound! can help detect and correct site problems. Web serving and Web monitoring services are another reasonable solution.

### On-site Intruders

It is probably as likely that your hardware will be stolen, or that someone will unlawfully access your office and make changes on your server, as it is that some nefarious, Net-based activity will lead to problems with your server. Exams in high stakes courses often have been locked away in departmental and college safes. Your server should receive similar respect relative to the traditional problems of theft and tampering.

### Internet Crime

There are several ways in which data may end up in unintended hands. The Internet is based upon breaking information down into packets, and sending these packets across a massive, dynamically-interlinked network. The packets that leave one computer and arrive at another may not arrive in the order sent, and they may not even traverse identical paths in getting from point to point. It is possible to intercept packets along the way – a process called **packet sniffing.**

As of this writing, there have been few reported cases where packet sniffing has been criminal. Nevertheless, to address this issue, browsers and servers often encode (encrypt) information so that, without the necessary codes or keys,

deciphering meaning from packets is nearly impossible. Whenever you see "https://," the associated data transactions are encrypted.

### Commandeering a Server

Hackers attempt to gain access to servers. There are two common reasons for these attempts. One is to obtain information from the server. Credit card information can be a prime target. Another goal of hackers may be to use your server as a launching device for some inappropriate activity. In this way, it seems as if the "attack" is coming from you, but it actually is coming from software that has been placed on your server without your knowledge. One way to forestall this kind of hacking is to have layers of servers, the first of which uses read-only CD-ROMs to store the key information. On the one hand, you will need to "burn" a new ROM every time you want to make a change. On the other, no one will be able to write to that ROM, so this is a reasonable security strategy.

The SANS Institute (System Administration, Networking, and Security) {U18.02}, "is a cooperative research and education organization through which more than 96,000 system administrators, security professionals, and network administrators share the lessons they are learning and find solutions for challenges they face." SANS has developed a list of the top ten {U18.03} most critical Internet security threats, and offers suggestions about ways to address these threats.

### Secure Socket Layers

**Secure Socket Layers (SSL)** encode sensitive information such as credit card numbers that pass between client and server by creating a temporary "key" (a digital code book) that enables the computers on either end to scramble and unscramble information. All the computers relaying the message see it as massively encrypted.

In order to enable digital commerce, a **certificate authority** uses conventional strategies (investigators, documentation, etc.) to establish a company's identification. Certificates are provided by a certificate authority such as RSA Data Security Inc. {U 18.04} or VeriSign {U 18.05}. The authority issues a unique "certificate" as proof of identity. When the client encounters a secure Web page, the hosting server sends a "hello" message. The browser then replies with a "client hello." The server sends back a "server hello." Exchanging these enables the two computers to determine the enabled encryptions. The computers also exchange a "session ID," a unique identifier for that specific interaction. The browser asks for the server's "digital certificate."

After a client and a secure server have shaken hands, and after the client has checked the server's digital certificate, the client uses information in the digital

certificate to encrypt a message back that only the secure server can understand. Using that information, the browser and the server create a “master key.” This master key is like a codebook that both sides can use to encode and decode transmissions. Only the client and the server share that “master key”, and it’s good for only for that individual session. When the session ends, so does the utility of the code book.

The drawing of a padlock or key somewhere along the bottom of your browser’s window indicates security (Figure 18.01). Browsers can alert you when you enter and leave a secure site.

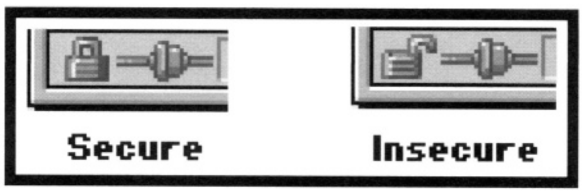


**Figure 18.01. Icon at bottom of browser software which indicates whether transactions are using a secure socket layer.**

## Attacking Servers

There have been reports of Internet crimes involving theft of information from servers. Credit card numbers have been specifically targeted. This type of theft is not limited to the Internet; many cases of credit card number theft have been reported in businesses with no Internet access. (These thefts are why most credit card forms no longer have carbon paper layers.) Teachers usually have no need to keep this type of information on a server.

In most cases, the most sensitive material teachers need to store on servers are exams and grades. Exams in high stakes courses have potential for theft. Passwords are a good first step toward security for these materials, but hackers have been known to “charm” password information out of unsuspecting employees with a good story line. Just a little bit of access is all they need. When storing materials with a high risk of theft, be sure to provide for layers of security, beginning with user IDs, passwords, and firewalls.

## Firewalls

A firewall is a hardware or software-based filtering mechanism that allows limited access to your site from the Internet. “Approved” traffic can move in and out according to a plan. You select the services necessary for your teaching, but bar others who may have significant security holes, or malicious intents. It may

be important to use software that attempts to detect and prevent inappropriate site access. *NetBarrier* is one example of a firewall.

> Do you know what really happens when your Mac is connected to the Internet or an AppleTalk network? Do you realize that if you are connected to the Net, the Net is connected to you? Uncountable numbers of malicious vandals are able to sneak their way into your personal files undetected. With the Internet, we have entered an era of an information security way, where everyone needs to be armed with a real-time response to any intrusion attempt.
>
> Experts estimate that between 85% and 97% of intrusions are never detected. This is essentially because computers are not protected correctly. But now, there is an optimum security solution available for Macintosh, to protect your computer from intrusions three levels of defense. *NetBarrier* combines a personal firewall, antivandal detector and a network filter.
>
> *NetBarrier* {U18.07}

## Facilitating Authoring Access to Remote Servers

A related issue is the need to facilitate access between machines. When building and maintaining a Web site, the work is often done from a variety of machines and locations. *Timbuktu Pro* software helps accomplish this. It is not necessary to be physically near a server to modify its content.

> *Timbuktu* Pro is ideal for people who own more than one computer, or need to collaborate with others over a LAN, through a modem, or over the Internet. *Timbuktu* Pro is essential for help desk, server, and web administrators. No more walks down the hall. No more trips to remote offices. You can even teach friends or family members how to use their computer right over the Internet! Experience the freedom to go anywhere knowing you can access your computer from home, hotel, remote office or wherever you are. With *Timbuktu* Pro you’re never out of touch.
>
> *Timbuktu* {U18.08}

*Timbuktu* allows logging on to the server from home or vice versa. Files can be moved using a straightforward interface. That’s the good news; that’s the bad news. Your machine is susceptible to hacking should anyone else with *Timbuktu* acquire your user ID and password.

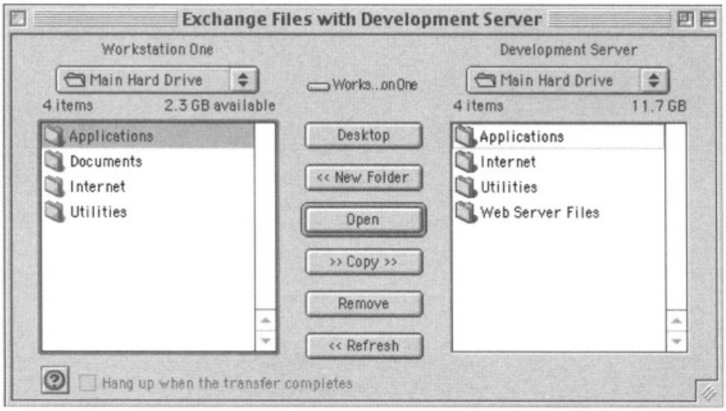


Figure 18.02. ***Timbuktu*** **file transfer interface. Move files over the Internet from office to home machines.**

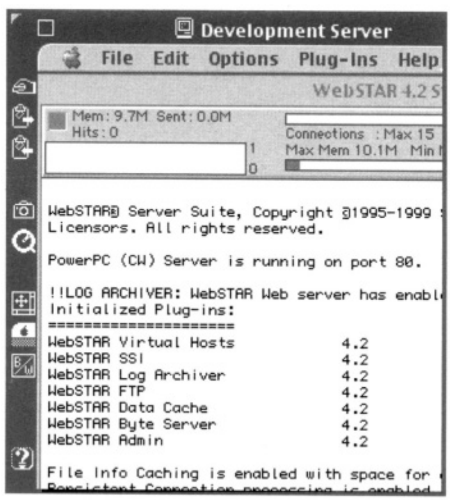


Figure 18.03. **Modified screen capture from *Timbuktu*. *Timbuktu* was controlling a server at one site from a different site.**

## CONTROLLING ACCESS

On the Web, the intent is to make most site information accessible to everyone everywhere. Even when specialized software (plug-ins, helper

applications) is required, these are nearly always both free of charge and readily downloadable.

For an intranet, a different philosophy prevails. Some universities and companies adopt an intranet approach to software licensing, and therefore they control access. Expect to see several strategies emerge for this. At UNL, *KeyServer* {U18.09} software is used. This software keeps track of the number of copies licensed for concurrent use. Each user has most of the program at their machine. When the software starts up, it seeks a key from the network. If a copy is available, the server sends back a key that permits use of the software. The number of copies available for use on the local network is reduced by one. When the user quits that software, the number of copies available increases by one. A problem arises when a copy is left running that a user no longer needs; the system depends on user courtesy for success. Key servers are generic solutions to the software licensing problem. Weblets, discussed in Chapter 17, offer another solution to protecting faculty authorship rights.

It is a straightforward matter to handle Web-based enrollment; it is much the same as selling something over the Web. *HyperCard*-based software could be used to gather individual student data in classes before the Web existed. Converting these packages to Web-based software turned out to be simple.

With *WebSTAR* {U18.10} software, controlling server access is easy. Protected materials are stored in folders. A proscribed character sequence within the folder's name indicates to *WebSTAR* that a user name and password must be submitted prior to access.

### Assessments (Exams)

Taking exams over the Web certainly is possible. Web exams are at the heart of the largest materials development project we've ever undertaken. Our strategy, however, is that all of these exams are really taken as practice for a written and/or oral exam to be given by a course instructor or proctor once the participating learner is ready to be tested. Not only are all of our exams public, but it is possible simultaneously to open a public page alongside an individualized page, glean enough information by repeatedly serving exams from the public page, and generate what amounts to an answer key response. In our approach, we make no attempt to determine who actually responds to the Web-delivered items. We focus entirely on a more traditional assessment, one that presents no difficulty for a learner who has the kind of understanding of the course material that good performances on our open exams would imply.

### Who's Responding – Biometrics

There are ways to do some verification of who's sitting at the client side. You may already make use of the most common of these – log-in ID with a

password. In fact, these can be quite problematic in the absence of an automatic way to handle them. A student always can give their ID and password to an expert who might then take their tests.

**Biometrics** is the statistical study of biological phenomena. As applied to verifying the identification of humans, biometric identifiers are physiological and behavioral characteristics that are completely unique to a person – their fingerprint, hand shape, iris patterns, face, and voice being among them. Access control can be very sophisticated. Figure 18.04, taken from the site of a company that sells systems to control access, illustrates access mechanisms. Together with voice, this reasonably sums up access control strategies in use at this time.

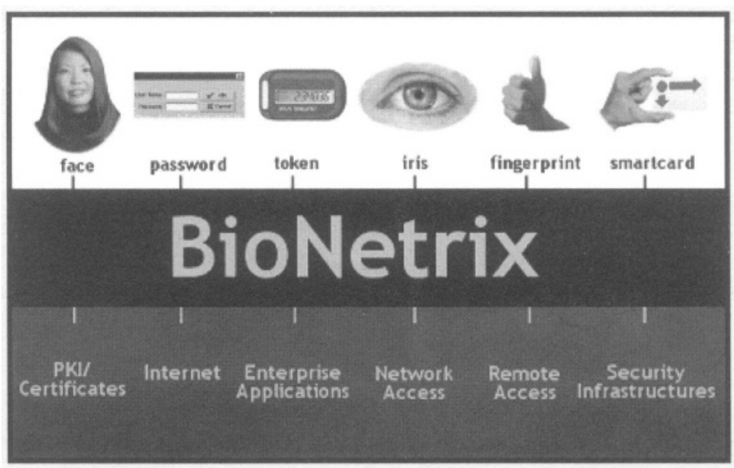


Figure 18.04. **Access strategies from Bionetrix {U18.12}. With Permission.**

Access strategies have turned away from ID's and passwords, and toward measuring a body characteristic. Thus fingerprints, handprints, iris patterns, face recognition, and sound or voice recognition serve as bases for identification. The larger commercial interests in this area are in systems like bank automated tellers. Today one uses a bank card and a password to access an account. That is likely to change to some biometric in the future. Several manufacturers offer fingerprint recognition software. Devices are readily available that lock others out of your PC. Fingerprints remain a gold standard for recognition (Figure 18.05). No inking of the fingers is necessary. Place the fingers on a recognition plate, and the device takes over. You can expect access to your money at an automated teller machine (ATM) to involve either fingerprint or iris access before too long, with truly world wide impact.

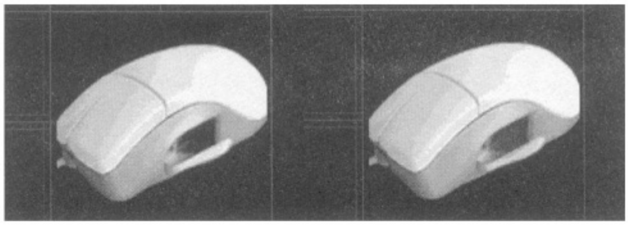

Figure 18.05. **Fingerprint checking mouse from BioLink {U18.12}.**

There still is a problem with this from a teacher's point of view. An expert might be standing right alongside a "fingerprinted" participant. Coaching deemed inappropriate could transpire without detection. For that reason, the idea of a TV camera with sound focused on the person sitting at the client terminal has attractions for teachers. This would be especially true if the system were to be automatic. *FaceIt* software, developed by Joseph Atick, serves this purpose.

The military has a special interest in controlling access. The U. S. Navy supported much of the research that led to *FaceIt.* The idea was to control gates such that only certain sailors could access a ship through its gang plank.

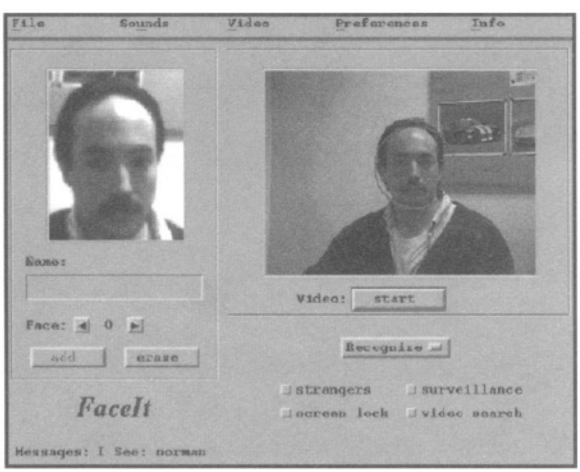


Figure 18.06. ***FaceIt*® software {U18.13} makes positive identifications of persons against a library of expected faces. "*FaceIt* Surveillance finds faces in video input and performs manual or automatic searches against a watch list of individuals. Automatically finds up to 10 faces simultaneously in a single video frame." The site claims a recognition rate of 15 million faces per minute. It also claims that the technology can work with medium or poor quality images captured from video.**

Another application is in bank security. In this situation, pictures are taken of customers and others, including thieves. From the images, a subsequent match becomes possible. It is possible to know with very high accuracy that a suspect is the same individual for whom one has video.

In Chapter 5, we discussed videoconferencing. Software systems for direct observations of students by teachers are already available.

Expect to see many approaches applied to computer testing. Certainly, when site access is controlled, it can be used for purposes of licensure, SAT tests, and so forth. The same system used by you for videoconferencing is likely to provide automatic identity verification – so that students can take secured exams 24 hours a day. The Graduate Record Examination {U18.14} of the Educational Testing Service is given as a computer examination. Students report to designated centers in order to take the examination. The exam is adaptive, and each student receives items as a function of their prior performance.

**Figure 18.07. Laboratory for Web-based testing at UNL. With the exception of proctors regularly on duty, this laboratory appears the same as many other campus computer laboratories.**

How you'll prevent collaboration, use of two computers, and similar problems related to examination performance remain open. Just having verification possible throughout an exam period may be adequate. Videoconferencing for verification after the fact is very powerful.

Teaching large classes presents special problems, however. With a class of 100 students, videoconferencing for verification would require 25 hours if only 15 minutes were spent with each student. Larger classes would be even more overwhelming. For some areas, a practice bank can be made so large that, with computer randomness about specific details included, learning the material is far easier than learning some strategies for just passing test items. As for the exams themselves, having a powerful system can make it possible to use the practice tests and the real tests interchangeably.

## GLOSSARY

biometrics: is the statistical study of biological phenomena. As applied to verifying the identification of humans, biometric identifiers are physiological and behavioral characteristics that are completely unique to a person – their fingerprint, hand shape, iris patterns, face, and voice being among them.

certificate authority: the Internet equivalent of a passport office. Certificate authorities issue digital certificates and validate the holder's identity and authority. CAs "embed an individual's or an organization's public key along with other identifying information into each digital certificate and then cryptographically 'sign' it as a tamper-proof seal, verifying the integrity of the data within it and validating its use." {U18.15}

packet sniffing: many network data analysis tools are able to capture packets and store them for later review. Though useful for problem analysis, this also permits capturing information, including sign-ons and passwords. Firewalls provide no protection against packet sniffing.

Secure Socket Layers (SSL): encode sensitive information such as credit card numbers that pass between client and server by creating a temporary "key" (a digital code book) that enables the computers on either end to scramble and unscramble information. All the computers relaying the message see it as massively encrypted. The keys are dynamic, and last for a single session. The systems depends upon organizations that verify identities and issue certificates of identity called certificate authorities.

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# CHAPTER 19

# Equity and Legal Issues

In the years that have elapsed since the publication of the first edition of *Web-Teaching,* legal issues have become clouded. New issues have emerged with respect to students. Today, distant learners using campus-based Web resources often are thought to be entitled to the same resources and privileges as traditional, on-campus students.

More frightening, however, are the equity issues that have arisen. After years of progress in these areas, it is becoming clear that the new technologies appear to favor majority males over members of other groups.

## EQUITY

### Uneven Access

A study conducted in early 1997 indicated that proportionately more than twice as many whites as African Americans had used the Web during the preceding week [Hoffman & Novak, 1998]. The racial divide was most pronounced for those persons who did not own a home computer.

A recent study showed a 24% drop in women pursuing computer science degrees over the decade of the 1990s. While no completely satisfactory explanation is available for this drop, one suggestion is that computer games are less attractive to girls than to boys [Gorriz & Medina, 2000].

It is difficult to see how these observations can translate into a more equitable society in the future. The Internet is becoming a mainstay of United States commerce. To be a player in this economy, it is necessary to understand how to use the Internet and the Web to the fullest advantage. Obviously, this favors those persons with the most experience and practice. While we are able to

report these differences to our readers, we are unable to offer any meaningful remedies. Only time will tell if these differences prove to create schisms in our society.

While reports from colleagues teaching graduate courses using the Web have not included observations involving gender differences, two reports of differences in undergraduate chemistry courses using Web supplements are of interest. Kimbrough [1999] suggests that synchronous chat sessions may be especially attractive to female students. Donovan & Nakhleh [2000] find more favorable attitudes toward Web and computer use by females than their male counterparts.

The strategies that you choose to employ as a Web-based teacher have potential impacts relative to equity. Webb et al. [1998] report on group composition relative to assessment. They find that low-ability students performed better in heterogeneous groups with high-ability students included. High-ability students, on the other hand, performed best in homogeneous groups with other high-ability students.

### Handicapped Access

The Web is primarily a visual medium, and, so far, hearing-impaired persons do not suffer any striking disadvantages with respect to Web access. An important issue yet to be addressed is access to Web materials for the visually impaired. Creating tags that provide brief text descriptions is a good first step. These descriptions can automatically appear in lieu of the image. (See Figure 19.01.) These alternative tags can also be useful for sighted users who elect to turn off images or use text-only browsers.

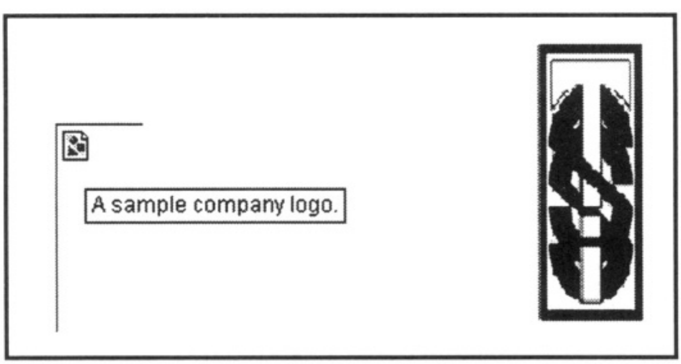


Figure 19.01. **The IMG tag for this file includes the element ALT="A sample company logo." The ALT text (left) appears if automatic loading of images is turned off, or in text only browsers. When the image is loaded, it appears as at the right.**

An important issue yet to be addressed by the Web is access for the visually impaired. When transmission speed is important or connection rate is slow, users may set their browser so images are not displayed. Creating tags that provide brief text descriptions of the images is important. These descriptions can automatically appear in lieu of the image. (See Figure 19.01.)

Suggestions for preparing materials more useful to visually impaired persons can be found on the Web. For example, see Enhancing the Accessibility of Digital Television for Visually Impaired People {U 19.01}. A Web-published book on adaptive technology [Mates et al., 2000] {U 19.02} addresses these issues.

## COPYRIGHT

There are two dimensions related to copyrights and Web-teaching. One deals with the use of copyrighted materials in Web-delivered courses. The other deals with the ownership of faculty-created electronic course materials.

### Using Materials in Courses

Under current copyright law, material written for Web sites, like all other forms of intellectual property, is copyrighted automatically. There may be a tremendous temptation to borrow something from a Web site for inclusion within the materials used in one of your courses. In spite of the fact that publication on the Web puts material out for all to see and use from a Web site, copying that material and transferring it to your site is potentially a copyright violation. The copyright law provides for "fair use" of copyrighted materials for educational purposes. Fair use generally includes the use of copyrighted materials for criticism, reporting, teaching (including a few copies for classroom use), scholarship, or research. Guidelines for fair use are not particularly clear; they call for judgment in their application.

Several factors usually are involved in determining fair use:

- purpose and character of the use, especially whether the use is commercial or for nonprofit, educational purposes
- the nature of a copyrighted work
- the amount of the copyrighted work used in relation to the whole work
- how the use of the copyrighted work affects market value

One complicating factor in the application of fair use is that of spontaneity. "If the work is used once and 'the inspiration and decision to use the work and the moment of its use for maximum teaching effectiveness are so close in time that it would be unreasonable to expect a timely reply to a request for

permission.' If the use of work does not comply with the standards of brevity and spontaneity permission from the copyright holder is required" [Jasa, 1998]. It is hard to imagine that a Web site developed for a course would meet the standards set forth under this spontaneity clause.

### Ownership of Faculty-created Electronic Materials

The creation of electronic courses has posed new problems in the relationships between faculty and administration. At one time, the authoring of textbooks was regarded as a private matter between a faculty member and a publisher. The employing institution was not regarded as having any special rights with respect to such products. Today, however, university administrations often seek ownership of electronic materials created by their faculty employees. This represents a significant change in the professor/university relationship.

A study group from the American Academy of Arts and Sciences has proposed the following policy: "The authors of scientific works based on government-supported research should be free to distribute those works as they see fit, via journals, electronic postings, and other new modes that may appear. Starting with this perspective, we offer a proposal to advance toward that goal in a way that accommodates the needs of both traditional and modern publishing" [Bachrach et al., 1998].

## PLAGIARISM

Plagiarism, broadly defined as taking written works of others and representing them as one's own, has always been a problem in assessment. With so much written material being available on the Web, teachers suspect that plagiarism is increasing. Papers placed in the files of student social organizations had a way of being resubmitted semester after semester. Students now can purchase term papers through the Web. Some sites advertise custom papers {U19.03}, and provide rush order services for delivering papers. What once was a mail order business, with ads appearing in campus newspapers, seems to have been transformed into a modern, worldwide industry, thanks to the Web.

Two strategies have been developed to deal with this issue. One invites teachers to submit writing samples to a database which then searches the sample for matches. Another suggests that teachers change the nature of their writing assignments to reduce substantially the likelihood that a "commercial" paper will be available. Custom authoring, to the extent that it really happens, simply brings this industry to a new plane.

While dealing with the veracity of submitted papers is a Web-teaching issue, it is neither new nor unique to the Web. While it might have been exacerbated by the Web because of easier access, it's the same old problem.

### Detection Strategies

Detecting plagiarism has become quite sophisticated. One writer points out that, because Alta Vista indexes the entire contents of each page, it is possible to submit strings of words found in the writing sample and determine whether these have been indexed.

Barbara Glatt, at one time a writing instructor, offers plagiarism services {U19.01}. These include instruction about plagiarism as well as methods of screening for and detecting plagiarism. Her screening program takes a writing sample and replaces every fifth word with a blank. The presumptive author (i.e., the student) is supposed to fill in those blanks. This test is then sent to Glatt who uses a statistical analysis attempt to determine whether or not the writing is original.

IntegriGuard {U19.05} uses the strategy of having students submit entire works. Having submitted the paper, the paper is searched against the entire database of all such papers. The company charges each instructor a fixed monthly fee for the service.

A company called iParadigms includes in its Web site (plagiarism.org, {U19.06}) information on plagiarism and fighting it. Plagiarism.org is a subdivision of iParadigms and claims to have developed proprietary plagiarism detection algorithms. They calculate a degree of originality as a characteristic indicative of plagiarism.

Viewed from a different perspective, there are those whose work merits protection. They seek to identify Web sites where illegitimate copies of their work might be made available inappropriately. WordCheckSystems {U19.07} provides software for this sort of monitoring.

### Anti-Plagiarism Strategies

Teacher s can, and likely should, work to discourage plagiarism. There are several ways in which this can be accomplished. One is to provide instruction about plagiarism. These instructions set down some markers for your students, and these seem to pay off. This is an option in Glatt's plagiarism services, for example. Make sure that you have written policies about plagiarism in place, and that the consequences of being caught plagiarizing are clear, enforceable, and consistent with institutional policies.

Stress the process aspects of writing. Insist on topic proposals, outlines, and drafts with revisions. Require specific components or sections within papers.

Try to get analyses that supercede those of traditional papers. For example, ask that students compare and contrast two different systems, countries, cities, substances, or industrial processes. Run the creation of papers as term-long assignments that build along the way. There might be a few short papers, an oral exam, etc. In a Web course, perhaps students would have to make reference to something that popped up during a threaded discussion. Insist on a research trail – not just URLs of references, but copies of papers cited.

Still another aspect of the process is to consider how you post your students' works. This obviously is a very powerful strategy for enhancing the degree of ownership that students feel in their work. At the same time, it is a potential source of papers for those actively engaging in plagiarism.

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# CHAPTER 20

# Multimedia Classrooms; Lecturing

The hardware for effective multimedia presentations in classrooms has been improving steadily. There have been remarkable improvements in projectors since our first edition was published. Both permanently mounted and portable devices are available that can project in well-lighted rooms. As with so many hi-tech devices, their prices seem to lower as their quality rises.

We've noted earlier and at length that students seem to like multimedia instruction and, as of this writing, rate it very highly. Instructors switching from traditional stand-and-deliver lecturing to multimedia strategies report substantially improved ratings from students on course evaluations. Teachers often report improved learning but, when asked to document such improvements, they rarely have supporting data. When measured using quantitative instruments, learning outcomes do not seem much changed. Indeed, performances in these "happy" classes often diminish (all other things being equal).

We have reliable, informal reports from effective teachers being asked by their students to use traditional methods of instruction rather than multimedia instruction [Meier, 1999].

## A MODERN MULTIMEDIA COURSE

In spite of our lack of enthusiasm for the simplest outcomes, we encourage you to convert your classroom presentations into Web-ready formats. Excellent instruction involves many dimensions, perhaps the most important of which

involves high minimum standards. Using multimedia, and especially Web-based testing, instructors can raise the learning performances of their students.

This chapter includes practical suggestions about developing multimedia classrooms. It has little to do with actual use of the Web. Putting multimedia materials into Web formats is a good approach for making in-class presentations. It has the advantage that, should you choose to do so, you can make some or all of those materials directly available to students over the Web.

## Lecturing

Because active learning is known to be more powerful than passive learning {U20.01}, lecturing generally is not regarded as a first choice teaching strategy. When lecturers are very good, and other formal contacts with learning don't exist (i.e., there are no related laboratories or recitations), the structure lecturers provide for learners who have poor self-regulation skills may provide those learners with what it takes to survive. The realities of postsecondary education are such that much lecturing takes place; students are expected to undertake active learning on their own outside of the lecture room. In areas where individual opinions and points-of-view don't carry much weight, the lecture can be a very effective as well as efficient mode of presentation.

An outstanding introductory chemistry lecturer from an excellent department once suggested that the lecturer "sets the pace and tells the students what parts of the book they're not responsible for" [Burmeister, 1980]. The more we learn about instruction, the more we accept this as a description of what goes on in many lecture classrooms. The lecturer also can clarify points, and can broaden the view far beyond that possible from a textbook.

When it comes right down to it, lecturing isn't all that bad. The motivational aspect of face-to-face teaching often is underplayed or even ignored. For experts in an audience, lectures can be a very efficient means of teaching. Besides, the resources necessary to do much better than lecture often are not available in postsecondary settings. Dare we say that we've even walked away from some lectures feeling inspired. (Also, on occasion, we've walked away nearly expired.)

### *An Old Multimedia Course*

One of us once taught all five lecture sections of 200+ students each in a large introductory chemistry course using multimedia [Brooks, 1985]. The course demanded very significant advance organization. (Because considerable advanced organization is required for Web-based, distance teaching, the work demand characteristics of these two seemingly different teaching environments are actually quite similar.) In this course, all of the new lecture content was presented using synchronized, lap-dissolve, slide-tape programs. (Lap-dissolve

involves using two slide projectors with superimposed images, and controlling these so that one is turned on as the other is turned off.) Published, printed classnotes allowed students to break down the material into coherent bundles (modules). There were occasional videotapes. There were many small-scale, live demonstrations that were broadcast over a television system within the lecture room. The image of a penny (U. S. coin) could be made to fill each of the 25-inch television monitors. The demonstrations often were spectacular on the screen. For example, a penny heated to glowing red and immersed in the vapors of certain chemicals continues to glow red as it catalyzes the burning of the vapor on the penny surface. There were in-class experiments, with data for all five sections analyzed on the following day. There was a televised bulletin board that greeted students as they entered the lecture hall. There was cooperative learning – students were asked to work with neighbors on specific tasks.

Because so much of the material was prepared in advance, and with help from an assistant for the live demonstrations, the physical demands of the class were not unusually great. With 15 to 30 minutes of canned material in each 50 minute period, lectures were very relaxed. The only days in this course that were tiring were the days (five of them) before hour exams when no new material was introduced, and the only activity was to respond to student questions. That was very tiring; there was no time to rest.

This course was very successful – the most popular among the required introductory science courses at UNL. Although the media presentations were "home grown," they were well done. The presentations were available on videotape – in a resource room – which students could access for review on demand. That room was open during all business hours and many evening hours every week.

All of the old course examinations going back six semesters were available on microfiche which the students obtained together with their class notes. At the time, a $0.15 fiche held an entire semester of exams (five hourlies, five repeat hourlies, and a final). Second to the TAs, the microfiche readers were the most popular game in town. Worked-out exams have an excellent history as instructional devices. Indeed, exams tell the tale of most courses [Tobias & Raphael, 1997]. Instructors and top students usually feel that "new" exams are very similar to old ones, but struggling students often feel that "new" exams are unfair, and unlike the preceding semester's exam.

Setting up the multimedia course cost $125,000. It was labor intensive; there were workers who did nothing but make slides day after day. Having helpers increased rather than decreased the total teacher time. Assistants would introduce errors, and their work would need to be reviewed carefully.

*An Idealized Multimedia Course*

Today the course described above would be developed in an entirely different manner. Classroom presentations could be handled with presentation software such as *PowerPoint* or in Web formats. With the Web formats, the number and length of in-class presentations could be reduced by providing Web materials for student use outside of class. When projected in classrooms, Web presentations would have the virtue of being extensible multimedia presentation devices; graphics, animations, or movies could be played within the file. In either *PowerPoint* or Web medium, a 14 or 18 point font size, sufficient for viewing from the back of the room would be used. Spell checking in *PowerPoint* or WYSIWYG software would reduce editing time. Live lectures would be captured for later use as streaming video. After any needed editing, the segments would be made available over the Web for later viewing by students.

In chemistry classrooms, the chemical demonstrations would probably be kept live. The sights, smells and sounds of chemistry would abound (within the limits set by OSHA). The smells of chemistry demonstrations are not yet Web-transmittable. And the sights and sounds of chemistry are not properly captured by the Web.

## MAJOR DEPARTURES

### Assessment

Up to this point, all that has been suggested represents the conversion of a traditional lecture course to a multimedia course. You can stop there. We wouldn't. All course exams would be online via the Web, repeatable, self-scheduled, with rewards and penalties attached to deadlines. There probably would be two deadline dates – an extra point or two for finishing before the first one, and harsh, daily penalties for each day past the second one.

Instead of worrying about proctoring tests, there would be required, live, in-classroom, conventional testing to verify learning. The verification would consist of retesting, in conventional ways, a randomly-selected portion of the material tested over the Web. When a student demonstrated success in the subset of testing items, we would assume that all of the material had been tested. (This is a modified Keller Plan or PSI system [Guskey, 1996 ]).

Any teaching assistants (TAs) would be expected to use computers to maintain office hours – including some at nights and over weekends. They would have the option of holding these office hours from their homes. Both hardware and Internet access for the TAs would provided by the university. There would be "chat rooms" available at several times during the week in which professors and TAs would answer questions.

## Curricula

The curriculum would change drastically, too. Substantial emphasis would be placed on the use of computer tools. The described course would still be a lecture course, but it would not look much like anything seen today. It would cost the university less to set up and run than the original course. The costs of the hardware, software, and Internet hookups would be transferred to the students. We currently run graduate courses this way, but these have much smaller enrollments than many introduction undergraduate classes.

# MULTIMEDIA IN THE GENERIC CLASSROOM

The scenario described above requires an equipped room. The large lecture hall of 15 years ago included a large chemistry demonstration table and a system for TV distribution throughout that room. The lecture room environment needs to be changed so that it is easy for the lecturer to accomplish multimedia goals, and easy for the students to make use of the multimedia environment.

Early in the days of lecturing using computers, the hardware was a very big deal. In 1988, one had to carry all of the hardware – monochrome liquid crystal display (LCD), computer (appropriately wired for an LCD), and a suitable overhead projector that at once put out lots of light but was, nevertheless, cool. (LCD panels are usually very heat sensitive, and older overhead projectors ran hot.) Power strips and extension cords were part of the paraphernalia. In fact, a lamp or flashlight to see in a darkened room was a primo lecturer's tool.

Today a specialized projection device can replace both the LCD panel and overhead projector. It is less cumbersome; it also weighs less.

## Smart Carts

In the first serious attempt made to put our university into a modern multimedia world, we constructed "Smart Carts." Smart Carts roll around from room to room. They need some scheduling. Also, because many persons access them, they have software messiness problems and hard-drive clutter. When compared with the first days of computer-based multimedia, however, they are wonderful.

Smart Carts (Figure 20.01) start out with the most powerful computer available. We purchase the largest hard drive, and extra RAM. We began in 1991, when a gigabyte and 16 megabytes of RAM were ample. The computer output was pushed through to a color LCD panel. This same panel also could take, as sources, a videotape player or a videodisc player. There were three image sources for the LCD. There was an enhanced sound system, capable of deafening levels. There was a 128-megabyte optical drive (a rewritable

technology, slower than others but less subject to accidental losses). Before extensive campus wiring, it was this gadget that kept our **"sneakernet"** going. The cart could be connected to whatever network was available.

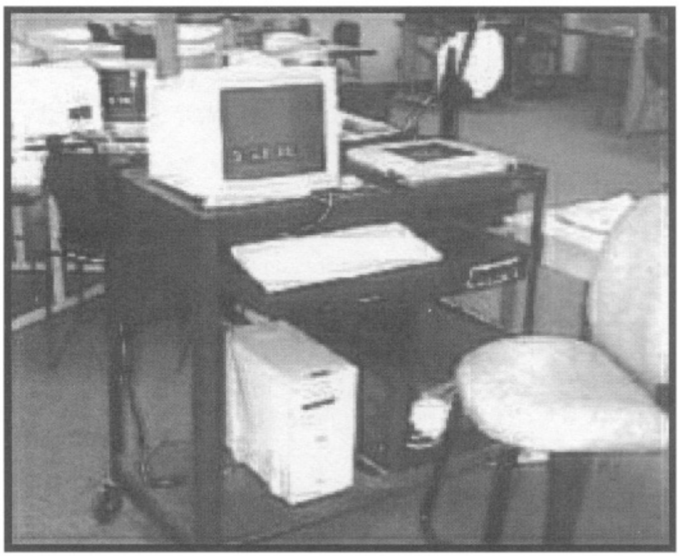

**Figure 20.01. The first UNL Teachers College smart cart: computer, monitor, overhead projector with liquid crystal display, and accessories.**

Today things are quite different. A cart might have a portable computer, a projector, and a sack with some cables. The computer output usually can be connected directly to the projector. Rather than being what amounts to portable furniture, today's cart is just a cart – a device to help in transportation. Our rooms have TCP/IP connections to the Internet. An instructor usually can hook up to the Internet without too much fuss.

Remarkably, there is a security issue involving this business. To prevent foreign computers from connecting to the network, our system polls newly connected devices to determine their unique, built-in ethernet addresses. It uses these to assign Internet addresses. Thus, special addresses need to be set aside to accommodate roving computers.

Smart carts usually don't travel well. They don't take well to elevators, and they are particularly prone to misbehave when taken out of doors between buildings.

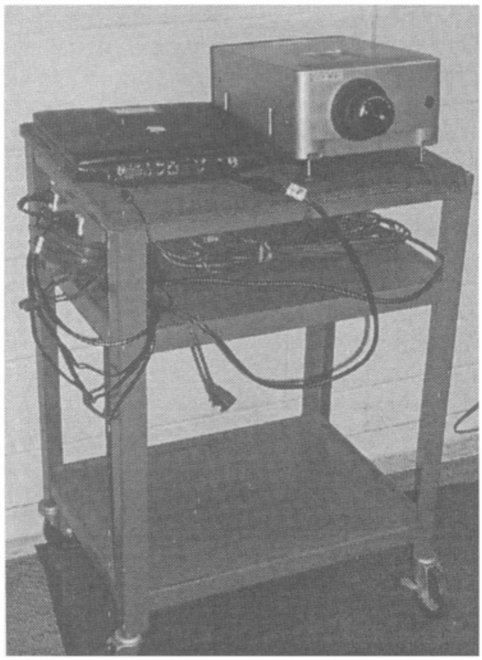

Figure 20.02. **Modern smart cart. A much smaller cart with a projector and a laptop computer.**

## Networked Resources

Courseware materials will be prepared in the office, laboratory, or media production center and be presented in a classroom. In the days of sneakernet, the information would be transferred by saving to a floppy disk and carried in your pocket. The smart carts included 3.5" drives. Now, transfer of materials is by network from the machines where the materials are created or stored to the machines used for presentation and teaching. Hardwired networking is one of the biggest efficiency enhancements in teaching.

## Display Devices

The first edition suggested that three display devices could be used: permanently installed monitors, LCD panels, and projectors. As of this writing, projectors have edged out the competition. They have become easier to maintain, and much less costly over time. (Focusing an old projector used to be something of an engineering feat.)

Ceiling mounted projectors are highly desirable; they are permanent fixtures. When installed, there will be some cabling to connect a computer to the projector. The projector usually is controlled using an infrared-based remote controller, and there needs to be a system to ensure that the "clicker" is available for all instructors to use. The room may need to be darkened somewhat, but the most modern of projectors run well in rooms that are nearly fully lighted. Projector costs have come down, and their maintenance has been simplified. This probably is the best, most teacher friendly solution.

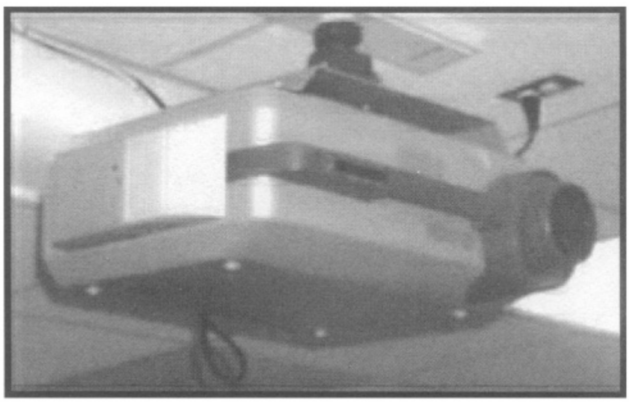

Figure 20.03. Ceiling projectors enjoy widespread use at UNL.

An incandescent lamp system with controlled output (dimmer switch) is extremely helpful in all multimedia rooms regardless of the image projection system.

## Computers

It has been our policy to put the biggest and best computer of the chosen platform in a multimedia room. In some rooms, we have placed both the best available Macintosh and Windows computers. This has proven to be one of our wiser policies. Smart carts end up being platform specific. If you have extra resources, think first of extra RAM and next of a large hard drive. Always, plan on connection to a network so that the teacher can download the materials from their personal desktop to the teaching computer.

In addition to the instructor's computer, a course incorporating multimedia modules might require computer access for the students during classes. Teaching in a computer lab or in a computer workstation classroom might also be an option for multimedia classes. For interactive multimedia, allowing

students to interact with animations, models, or input/output problems might be the most effective strategies for student learning. In a computer lab, the instructor might also use the students' monitors to display examples of problems, or to illustrate a programming process. Controlling students' monitors in a lab setting is done easily with network administrator tools. The number of computer workstations made available might allow students to work in small groups to accomplish the multimedia activities for the class period.

For course Web-based supplements and activities, classrooms equipped with **Internet appliances** offer one possible solution. The New Internet Computer (NIC) {U20.02} and the i-Opener {U20.03} are early among the devices being offered. Some of these machines are specifically targeting increasing connectivity in both K-12 and higher education classrooms. An Internet appliance is significantly less costly than a PC (of any operating system). The effectiveness of Internet appliances in classrooms remains to be documented.

Wireless hand-held devices such as the Palm VII {U20.04} also are being introduced for accessing the Internet. These may become useful access devices for students to use in any classroom.

## Videotape

Nearly all disciplines have valuable video resources available. In the United States, nearly all these video resources are currently in VHS format. It makes sense, therefore, to include VHS playback capabilities in any system you might develop to enhance lecturing. Choose projectors which handle videotape replay.

## In-Class Video Stands

The video stand (Figure 20.04), a television projection device, is emerging as a very useful tool. It captures the image of almost anything set on its platform and displays it on a screen. Using these, material can be shared effectively with an entire class. Books and reprints can be projected to be read easily. Pictures and photographs can be displayed quickly and easily. Most Web material requires advanced planning. Using video projectors, materials created during a class can be displayed. These devices support multimedia spontaneity and student input.

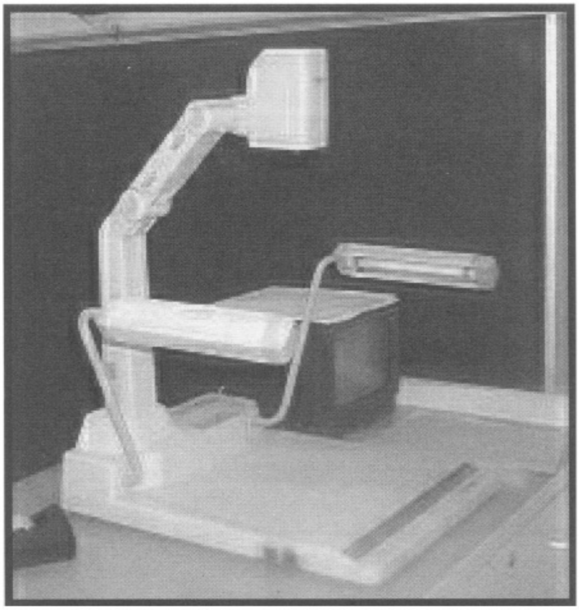

**Figure 20.04. A video projector stand (Canon RE 600 MK 11 Video Visualizer). A very useful tool for teaching many disciplines.**

## Seating Arrangements

There is much less variation in the layout of lecture halls than in labs. In lecture halls, think about a design that minimizes the distance between the teacher and students. This means that short and fat is preferred over long and lean. (Imagine a rectangle. The teacher needs to be placed near the middle of a long side, if possible.)

Classes taught with Web materials are best if the students are in control of the material. This means the students need to have access to the materials on computers. Classes may be taught in a school-managed computer laboratory. The design of the computer lab will impact upon the kind of learning environment achieved. Computers arranged in rows (Figure 20.05) tend to cause students to work individually; other arrangements actually promote student exchanges more and facilitate teacher access. The hexagonal arrangement show (Figure 20.06) works well and seems to accommodate nearly as many students as the linear arrangement.

Figure 20.05. Traditional arrangement of computers in rows, with 40 independent stations, all connected generically to the building network and all Web accessible. This is a university sponsored community or open laboratory. This lab rarely is used for teaching.

Figure 20.06. Classroom at UNL showing hexagonal pod (6 student stations), a very desirable arrangement that encourages student/student exchanges and facilitates faculty observation.

## THE MULTIMEDIA CLASSROOM

The UNL campus today has dozens of multimedia classrooms. Some of these are large (200-250 seats), while others are more modest in size (30-50 seats). We do tend to convert the big classrooms where large, introductory

courses are taught. The biggest advantage of these rooms is that the hardware is stored in a locked cabinet. Finding a simple, single system that permits control of all of the hardware simultaneously is a challenge. Many faculty undertrain and get stuck just before class. Sometimes the systems are fragile, and need lots of tender loving care during frequent maintenance periods. Once a faculty member has been burned in a multimedia room, they tend to drop out. About half of the burned faculty users drop out on our campus; wooing them back to multimedia use is a challenge.

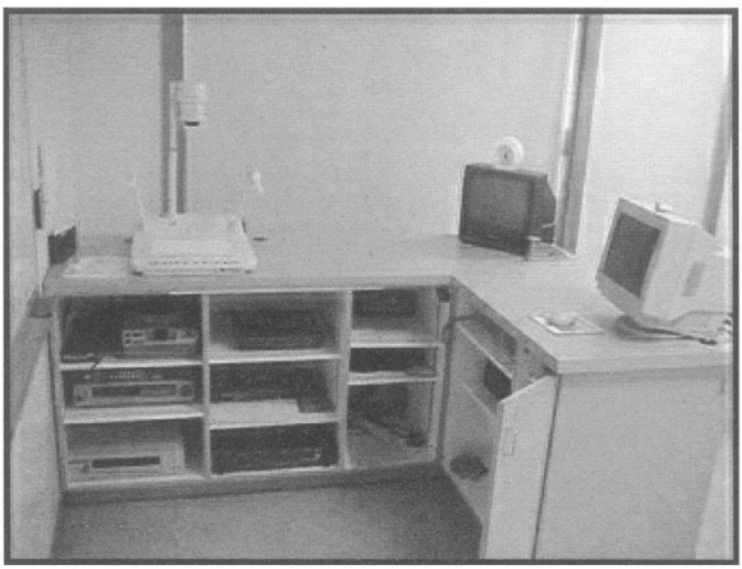

**Figure 20.07. The teacher's podium in a modern, multimedia classroom. Instructors can easily project video tapes, slides, audio tapes, computer resources, or the 3-D overhead projector to enhance their instruction.**

## WHAT NOT TO DO

Control is one of the biggest issues faced when designing a room. Who has control: staff in charge of the room; the teachers; the students? A teacher we know with good technology skills was asked to teach two sections of a course in technical communications, one on each of two campuses. She planned all sorts of student interactions including using e-mail, creating HTML pages, and using presentation programs. She planned to use supporting media in class, such as videotapes.

On one campus, as a result of room design and in spite of four hours of training, she had great difficulty in performing such simple tasks as showing videotapes. There were just too many power switches located in different places that needed to be turned on. When she tried to give students access to the same software she had at her terminal (this is a lab with about 30 student stations equipped with powerful computers), campus policy forbade student use of the same programs. That campus licensed software for use on individual machines, while the other one used a key server. With a key server, all machines can have a nearly functional copy of all licensed software, but, once the number of licenses available is in use, the key server will not serve keys to other machines. For the teacher to make this software instruction work, she would have needed to hold class in a student lab with all computers equipped with that software. On the campus with the key server, achieving all of her goals was no problem.

This teacher became very discouraged. When operating in one environment, teaching was straightforward; in the other, teaching using multimedia presented too many barriers. She stopped trying to use technology in her teaching.

The use of technology in classroom teaching continues to improve. In 1988, we lugged low quality hardware into every room intended for our technology use. Today we usually can find excellent multimedia rooms, even ones where our students also have powerful computers. We see this aspect of teaching as improving steadily on our campus and on most other campuses as well. Using a campus network, we move material from our offices to the classroom. The most difficult step remains finding an open time to test the software before class.

Lecturing is probably a better teaching technique than many suggest. Multimedia lecturing using Web-software is relatively easy and powerful. If you've not wet your feet yet, this is a comfortable and personally rewarding place to start. After a few years, it may grow on you so much that you compete to become your departmental Webmaster!

## INTERNET 2

Internet 2, begun very late in the 20th century, links research universities with high speed, high bandwidth connections. When this technology came on the scene, there was not a great deal of novel use. Bandwidth and speed are important to reduce Internet traffic congestion. Most of us were delighted to see our old pages, none of which were as much as a half-decade old at the time, served faster.

What kind of experiments were possible? One was face-to-face communication between severely handicapped persons being asked to serve as advisors on panels addressing the issues of the handicapped. Our colleague, David Beukelman, seized on this specialized teleconference opportunity.

Another application related to interactive courses taught at a very high level. These courses often are found in the sciences – sometimes as formal courses, and sometimes as research group seminars. Martin Dickman teaches such a course in plant pathology. Dickman identified two colleagues with complementary professional interests, Jan Leach at Kansas State University and Tom Wolpert at Oregon State University. Together, the three of these faculty started sharing a course called Molecular Plant-Microbe Interactions. While all three are experts, their areas do not overlap completely. An anticipated effect of such a course, therefore, was to increase depth. Because the three campuses did not have the same research equipment, the course afforded opportunities for meaningfully shared exposure to sophisticated hardware.

In order to accommodate the Internet 2 technology, the course was scheduled into a distance learning room with special hardware. Each of the campuses invested in an Optivision VS-Pro system {U20.05}, and each used a similarly equipped room. (These rooms often are used for satellite television narrowcasting.) The idea was that all three classrooms were connected in real time to one another with high quality video signals. Each room had all of the types of hardware described in this chapter; nearly any physical or multimedia material could be shared equally well between all three sites. The room used at UNL is shown in Figure 20.08.

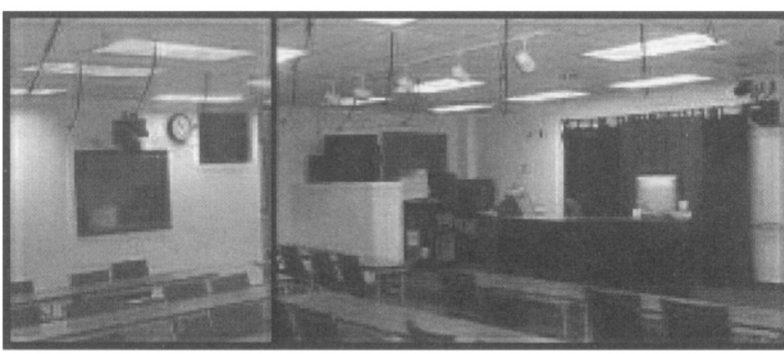

**Figure 20.08. Distance Learning Classroom at UNL. Typically used for satellite or in-state network television, this room was equipped to accommodate Internet 2 (4 Mbit) television, both in and out. Left view: control room, with video camera above window. Right view: instructor podium, monitors for viewing from other sharing sites, camera. The dark rod-like objects hanging from the ceiling throughout the room are microphones.**

The initial results from this experiment were very successful. During the first offering, 27 students participated. This was a bit large; one of the campuses had some students not ready for such a prime-time interactive experience.

The most positive outcome was that sharing the deep expertise and specialized equipment really did seem to pay off. The negative outcomes involved having students surrounded by the needed technology in a rather foreboding environment. The worst of these tradeoffs involved scheduling – one group attended at an unusually early hour, and the specialized rooms had to be vacated by the specified end-of-class time. (Advanced courses often end on a natural schedule, not a fixed schedule – with the lead faculty adopting a "we're done when we're done" attitude.)

This three-campus course used many of the Web-teaching techniques described in the earlier chapters of this book. Just like the Web, there are other teaching strategies that have been enabled by the Internet. This is an interesting and potentially powerful one.

## GLOSSARY

internet appliance: a computer of varying specifications that connects to the Internet to provide Web browsing and e-mail capabilities usually without the use of a hard drive for storing other applications or data. These devices may vary from desktop to hand-held models.

sneakernets: facetious name given to the method of transferring information using floppy discs or similar media. The notion is that persons must physically carry the information, and that they might wear shoes called sneakers.

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# Glossary

active learning: learner speaks, writes, performs experiments, plans, etc., as opposed to reads, listens to lecture, etc.

animation: as used in *Web-Teaching*, a sequence of drawings or graphic images stitched together to form a movie.

ANSI (American National Standards Institute): the organization for fostering the development of technology standards in the United States.

applet: an application written in the Java language intended for inclusion within a Web page.

ASP (Active Server Page): an embedded server-side script used to serve interactive pages instead of using more traditional CGI programs. It includes a database-access component.

asynchronous discussion: discussion occurring at different times (such as messages posted to a discussion board).

asynchronous: used as an adjective in Web-teaching jargon to describe situations where learners and teachers are separated in time and usually in space.

attach: to add a copy of a document (attachment) to another document so that the first acts as a carrier for the second.

attribute: in HTML programming, attributes are settable properties of elements.

audiotutorial system: structured learning system in which audiotapes provide the instructions. Many other media may be involved.

bandwidth: in Internet jargon, the amount of electronic information that can be delivered per unit of time.

biometrics: is the statistical study of biological phenomena. As applied to verifying the identification of humans, biometric identifiers are physiological and behavioral characteristics that are completely unique to a person – their fingerprint, hand shape, iris patterns, face, and voice being among them.

Boolean: a system developed by mathematician George Boole, logical variables are represented by the digits 0 (false) and 1 (true). A Boolean expression evaluates to true or false. Consider the expression *A* AND *B*. In this scheme of logic, for the expression to be true, both *A* and *B* must be true. The Boolean logic operators are AND, OR, NOT, NAND, NOR, and XOR. For OR to be true, *A* can be true, *B* can be true, or both *A* and *B* can be true. For NOR to be true, neither *A* nor *B* can be true. For NAND to be true either *A* or *B* must be true, or neither can be true, but both cannot be true at the same time. For XOR to be true, either *A* or *B* must be true, but both cannot be true. Booleans are used extensively in computer programming. Boolean expressions are used widely in Web searches.

bot: short for robot or "knowbot." Also called crawlers and spiders. A search program, sometimes called a software agent. Bots search multiple sites simultaneously, can eliminate dead links, can download pages, use sophisticated search refinement, and can generate reports.

broken link: Web pages tend to be dynamic and often are revised, removed, or relocated. The links in one page that tie to another, especially between different sites, are not automatically updated. Broken links are the result. When a broken link is clicked an error message such as "file not found" or "Error 404" results.

browser: software that makes use of URLs and the Internet to obtain information (files) from a server. Most have graphical user **interfaces** (GUI). Examples are *Netscape Communicator* and *Internet Explorer.*

bulletin board: a scheme for accessing posted messages. One computer would be designated as a host. Access was by telephone through modems.

bundled: a package containing several related products, such as a piece of hardware together with one or several software packages used in conjunction with the hardware. The software packages often are limited editions of very well-known, powerful applications that urge the purchaser to upgrade to the full version, at extra cost.

cache: a temporary storage place. This can be a folder where files are stored, a chip where memory is stored, or a disk where something is written to the disk temporarily.

CD-ROM (Compact Disk Read-Only Memory): a storage medium, originally used mainly by developers to package their product. Now available for use by the consumer, both a write-once-and-keep-forever and a write/erase/rewrite form are available.

certificate authority: the Internet equivalent of a passport office. Certificate authorities issue digital certificates and validate the holder's identity and authority. CAs "embed an individual's or an organization's public key along with other identifying information into each digital certificate and then cryptographically 'sign' it as a tamper-proof seal, verifying the integrity of the data within it and validating its use." {U18.15}

CGI (Common gateway interface): the connection between the browser and server that runs a program. CGI programs can set and read small amounts of text on the client machine (called cookies), get and tabulate browser and operating system information, and so forth. By using CGI rather than browser-based scripting, nearly all users will be able to make full use of your pages. CGI scripts usually are not limited by browser or firewall limitations.

clicking, click: to depress a mouse button; depression of button on a mouse.

client: in Web jargon, this is a receiver of information, a connection to the Web where browser software is used to view materials served from somewhere else on the Web. The "opposite" term is server.

cognitive artifact: according to Donald Norman, a device created to assist with a task that changes in a fundamental way the skills needed to succeed with the task.

comprehensive multimedia delivery system: a delivery system capable of delivering nearly all media formats – text, sound, images, movies, etc.

compression; compressed file: file in which wasted space has been removed by using a computer application that replaces current bits and bytes with new ones. Formulas or algorithms allow duplicate or empty space removal, and also permit reconstruction of the original file identically (**lossless** compression) or nearly identically (**lossy** compression).

computer adaptive testing: the test-taker's ability level relative to a norm group is estimated iteratively during the testing process. Items are selected based on the current ability estimate. The procedure is thought to maximize the information about the test-taker's ability level. Test-takers receive few items that seem very easy or very hard. Testing ceases at a given level that is the test-taker's highest sustainable performance.

cookie: a small amount of text information that a server writes to your hard disk so that it can recall something later. Cookies often record preferences when using a particular site. The cookies that have been stored on a hard disk can be viewed in the latest implementations of *Communicator* and *Internet Explorer.*

courseware (course management software): computer software designed to support the activities normally incorporated by a teacher in an online course.

crawler: see bot.

digital camera: records image as digital information on some digital storage medium (like a memory card).

digital technologies: technologies in which information is dealt with as strings of zeroes and ones rather than as a continuous (analog) signal.

domain name: easy-to-remember address used for identifying and locating computers on the Internet. These are translated by the Domain Name System (DNS) into the numeric IP addresses used by the network. Domain names must be unique.

draw; drawing program: graphics program that creates image elements using vectors whose appearance can be modified by selection followed by changing a parameter. [Contrast with paint programs that store information on a pixel-by-pixel (dot-by-dot) basis.]

drive space: the amount of room available on a hard drive. At one time, PCs with 10-megabyte drives were thought to be huge; today 2-gigabyte drives are small.

DVD (Digital Versatile Disk; originally called digital video disc or disk): an evolving format for compressed, digital video.

elements, HTML element: in HTML programming, an element is contained between a pair of tags. As used in this Chapter, elements are entities contained with the FORM element.

e-mail: electronic mail delivered and received over a digital network such as the Internet. Software creates, transmits, and interprets the data streams.

face validity: a proposition has face validity when it seems reasonable, rational, and appropriate without any need for further justification or research. It describes a situation where an argument makes sense to the person hearing that argument to the degree that no further support is needs to affirm the validity of the argument.

feature set: in software jargon, a set of operations provided in a particular software package. For example, browser software is expected to include making, editing, and displaying bookmarks as part of its feature set.

firewall: allows limited access to your site from the Internet. "Approved" traffic can move in and out according to a plan. You select the services necessary for your teaching, but bar others.

FORM: an HTML tag that permits incorporation of interactive elements such as text fields, radio buttons, and checkboxes into an HTML document (Web page).

frequently asked questions (FAQ): some questions seem to arise over and over in asynchronous conversations, listservs, and newsgroups. To address this problem, create a file of frequently asked questions together with answers, and make that file readily accessible.

ftp (file transfer protocol): a procedure for transferring files from one computer to another.

GIF (Graphics Interchange Format): a pixel-based image format created by CompuServe and used widely on the Web.

helper application: program used by a browser to assist with some task or operation. For example, *Navigator* uses the helper application *StuffIt Expander* to translate and expand .hqx (dot hqx) files.

hot spot: an area of the screen which, when clicked, is expected to bring about some action such as moving to a different section of text, playing a movie, showing in image, etc. When the pointer (cursor) moves onto a hotspot, the shape of the cursor changes to that of a hand with a pointing finger.

HTML (Hypertext Markup Language) HTML tag: The Web involves sending files around the network in extremely simple formats so as to make them machine and platform independent. Inside these text files are "tags" read as text but demarked in such a way as to provide information to the software (browser) about how to display the text. This is not an exact method; the files may appear rather differently on different browsers.

http (hypertext transfer protocol): a procedure used by computers to transfer files from servers to clients (browsers). This is the principal procedure used on the Web.

hyperlinks: attributed to Ted Nelson {U01.03}, hyperlinks allow one to access documents in parallel, to jump from one to another on the basis of both content and relatedness. For example, if the name Ted Nelson in this description were hyperlinked, placing the cursor on the name and "clicking" would bring up information somehow related to Ted Nelson.

hypermedia: multimedia linked so as to permit branching from one place to another based on the intent of the user (or programmer).

hypertext: text linked so that the user can jump from one idea to another, usually by clicking on text.

image map: an image with embedded clickable hot spots that serve as hyperlinks.

interface: as used here, name given to the computer screen or screens that enable a user to interact with a computer program.

interlaced; interlacing: the scheme for sending sliced sections of an image in an alternating fashion to make images viewable more quickly. As more information becomes available to the browser, the interlaced image sharpens.

internet appliance: a computer of varying specifications that connects to the Internet to provide Web browsing and e-mail capabilities usually without the use of a hard drive for storing other applications or data. These devices may vary from desktop to hand-held models.

Internet Service Providers (ISPs): in the United States, access to the Internet is nearly always provided by commercial sources. Universities pay for this access, as do individuals. Cost and speed of access become issues for students.

Internet: a dynamic electronic network that permits computers connected anywhere on that network to exchange information. The Internet is essentially a worldwide network.

intranet: a private network that is contained within an organization such as a university or school district. It usually includes connections through one or more gateway computers to the Internet through firewalls – security systems designed to control all sorts of activity. The main purpose of a school intranet is to share school information and computing resources among faculty, students, and staff. An intranet uses the same protocols and methods as does the Internet: TCP/IP, http, etc.

IP address: a unique, numeric identifier used to specify hosts and networks expressed as four numbers between 0 and 255, separated by periods, for example: 129.93.84.115. These are handled through the American Registry for Internet Numbers {U10.12}.

IP address: computers on the Internet are identified by a unique number called an IP address. These consist of four numbers between 0 and 255 separated by three periods (dots). IP addresses are provided Internet Service Providers (Chapter 4).

ISO (International Organization for Standardization ): a federation of national standards bodies. Many countries have national standards organizations (like ANSI) that contribute to ISO standards setting.

item response theory (IRT): was developed to overcome shortcomings in the "true score" testing model wherein learners were assigned a score on a test, and that score represents the persons true ability. IRT looks at items, and expects persons of similar ability to perform similarly on an item. In this terminology, a test is unbiased when all testers having the same skill level have an equal probability of getting the item correct. If persons of similar

ability but different gender perform differently on the item, then the item is said to be biased.

Java: a programming language developed by Sun Microsystems made especially for Internet applications.

JavaScript: originally called LiveScript, a language developed by Netscape to enhance the interactivity of client-side materials by incorporating the programming with the materials downloaded to the client.

JPEG (Joint Photographic Experts Group): standard for a lossy compression format used for images and *QuickTime* movies.

Keller Plan: a self-paced, mastery teaching strategy. Information is broken into multiple sections or units, with tests for each unit. To proceed through the course, the student must achieve a mastery level of learning in each unit. Grades are based on how many units are completed.

Kinko’s: commercial supplier of information handling services centering on multimedia production and especially duplication services.

LINUX (pronounced LIH-nuhks with a short “i”): a UNIX-like operating system that was designed to provide personal computer users a free or very low-cost operating system comparable to traditional and usually more expensive UNIX systems. Linux has a reputation as a very efficient and fast-performing system. Linux's kernel (the central part of the operating system) was developed by Linus Torvalds at the University of Helsinki in Finland.

listserv: an automatic mailing system such that, when someone sends mail to the system, a copy is transmitted to all subscribers.

lossless; lossy: descriptions of file compression strategies. Lossless compression retains all of the information so that the compressed file may be reconstructed exactly. Lossy compression involves some loss of information. JPEG and MPEG are lossy compression formats.

map: a clickable image such that, if clicking occurs in a “hot spot,” some action will be taken. On the Web, this usually means activating some hyperlink.

meta-search: search the databases of multiple sets of individual search engines simultaneously from the same place and from the same screen. They provide a rapid means for deciding which search engines merit wider attention.

MIDI (Musical Instrument Digital Interface): a communications protocol between electronic musical instruments and computers

MIME (Multipurpose Internet Mail Extension): standardized scheme that permits browser software to determine what to do with a file. The file is assigned an extension written as a few letters and a period or dot. Files ending in .html or .htm, for example, are interpreted as being HTML tagged text. Files ending in .gif are GIF image files, while those ending in .jpg or jpeg are JPEG images. A file ending in .hqx has been encoded (in a format called BinHex 4.0) so that it can be transferred from computer to computer.

mirror: the use of multiple sites with duplicate information. Used to provide instantaneous backup for servers or alternate locations for downloading files.

MNG (Multiple-image Network Graphics): an emerging format to deal with Web-based multimedia.

motivation: the process whereby goal-directed activity is instigated and sustained.

movie: in the context of this book, a computer file that may be played by a computer as if it were a motion picture.

MPEG: a lossy compression format that is very efficient for movies. Requires hardware (chip) to replay from most desktop computers.

multimedia: forms of media, such as video, audio, text, and images.

news groups: originally, a bulletin board organized by topic. News groups have evolved to offer systematic access through e-mail or Internet.

node: a computer which serves as a point of exchange in a an inter linked group of computers, receiving, routing, and retransmitting information. Node is also used to indicate any computer on the Internet.

Optical Character Recognition (OCR): a scheme for taking printed images as from typewriting, newspapers, and books, and converting those images of letters into digital text files usable by computers.

packet sniffing: many network data analysis tools are able to capture packets and store them for later review. Though useful for problem analysis, this also permits capturing information, including sign-ons and passwords. Firewalls provide no protection against packet sniffing.

page: describes a hypertext file transmitted from server to client using the Web.

paint; painting program: image strategy involving individual dots or pixels in a screen. Cumbersome to modify after files are created.

.pdf; (Portable Document Format): a file format developed by Adobe that has captured all the elements of a printed document as an electronic image.

Perl: a high-level programming language with process, file, and text manipulation facilities that make it particularly well-suited for CGI script authoring.

Photo CD: digital format developed by Kodak and used to create optical storage media holding very large amounts of visual information.

pixel: dot on a computer screen. There are typically 72 dots per inch on a computer screen.

plug-in: dynamic code modules, native to a specific platform on which a browser runs, that enhance the capabilities of the browser.

PNG (Portable Network Graphics): a pixel-based image format.

portal: a Web site or service that offers a broad array of resources and services, such as e-mail, news, weather, forums, search engines, and online shopping malls. Most of the traditional search engines, such as Yahoo, have transformed themselves into Web portals. Courseware providers are seeking to establish themselves as portal sites. They have interests in two portal strategies: one for students, and the other for faculty as researchers.

RAM (Random-Access Memory): Space in computer where programs and data are stored while in use. At one time, 64K was large; this manuscript was produced on a system with 192 megabytes.

scan; scanner: to scan an image is to create a digital file from the image. A scanner goes from analog information (the picture itself) to a digital file from which the image can be recreated on a computer display device.

search engine: search engines are huge databases. They contain URLs for Web pages. Search engines compile their databases by using software agents (programs called bots, crawlers, or spiders) to crawl through Web space from link to link, identifying and perusing pages. Bots often index most of the words on the publicly available pages at the site. Search engines, actually search through a database using keywords and phrases, and differ

in size, speed, and content. No two search engines use exactly the same ranking schemes, and not every search engine offers exactly the same search options. Search engines use rules to rank pages. No two search engines are identical. Because the Web is a dynamic environment, similar searches performed hours apart may give markedly different results, especially when current events are searched.

Secure Socket Layers (SSL): encode sensitive information such as credit card numbers that pass between client and server by creating a temporary "key" (a digital code book) that enables the computers on either end to scramble and unscramble information. All the computers relaying the message see it as massively encrypted. The keys are dynamic, and last for a single session. The systems depends upon organizations that verify identities and issue certificates of identity called certificate authorities.

self-regulated learning (self-regulation): the active, goal-directed, self-control of behavior, motivation and cognition for academic tasks by an individual student.

self-regulator (self-regulation): a learner who actively controls his or her learning by use of good strategies for cognition and motivation.

server: computer connected to the Web that transmits files. Most computers can be made into servers given suitable software. *WebSTAR* can make nearly any Macintosh into a server. The "opposite" term is client.

shareware: software created as a public service and provided for testing after which, if used for substantial time (usually defined as a month), the user is honor bound to pay a small fee to the creator.

sliced; slicing: breaking the image file into several chunks for transmission.

sneakernets: facetious name given to the method of transferring information using floppy discs or similar media. The notion is that persons must physically carry the information, and that they might wear shoes called sneakers.

spider: see bot.

spreadsheet: software to handle systematic arithmetic and logic operations. Originally created to help with bookkeeping operations. (Spreadsheets vaulted personal computers to the desktops of everyday business managers.)

Sputnik: a space satellite launched by the Soviet Union. The Soviet Union was a political entity that included Russia. After World War II, the United States and the Soviet Union engaged in a world wide political activity known as the "Cold War."

subject directory: directories are edited by experts. They are organized into hierarchical subject categories, and sometimes annotated with descriptions. They do not have access to full-text documents. Only subject categories and descriptions may be searched. An example is Yahoo! {U04.06}.

synchronous discussion: simultaneous discussion. Occurring at the same time (such as chat or videophone).

synchronous: used as an adjective in Web-teaching jargon to describe situations where learners and teachers work at one common time and usually in one common place.

tag: in HTML, code embedded within an ordinary text file that may be interpreted by browser software as an instruction. Tags are markup instructions for text that are embedded in text. In HTML, tags are set off by the "<" and ">" symbols. Tags are programming instructions.

TCP/IP (Transmission Control Protocol/Internet Protocol): the communication protocol of the Internet. TCP assembles a file into smaller packets that are transmitted over the Internet and received by a similar program that reassembles the packets into the original message. The IP handles the address part of each packet so that it gets to the right destination. Each network computer checks this address to see where to forward the message. In principle, packets may arrive via different routes. A client requests and is provided a service (such as sending a Web page) by a server. TCP/IP is from one point in the network to another. Each client request is considered to be a new request, one unrelated to any previous request. The "connection" is maintained only until all transmitted packets have been received.

telnet: a remote terminal connection service that allows a user at one terminal to interact with systems at other sites as if the user's terminal were directly connected to the other sites.

thread: in Web-based discussions, a way of linking contributions (posts) which address the same or closely related topics. Responses to the original post are automatically linked to it.

thumbnails: small image representations of larger images intended to facilitate either looking at or managing the larger images. Thumbnails have much smaller file sizes than their corresponding full images, and download relatively quickly in Web pages.

UNIX: For all computers there is some core software that runs underneath everything else called the operating system. UNIX is a computer operating system designed to be used by many people at the same time (it is multi-user) and has **TCP/IP** built-in. It is a very common operating system, and the majority of Internet servers use this system.

URL (Uniform Resource Locator): a five-part information string that conveys a type of operation (e.g., http, ftp, mailto), the **IP address** of a machine (or its alias) where the desired file is located, the path on that machine to the file, the name of the file, and, through 2 to 4 letters appended to the file name in what is called an extension, information about the nature of the data in the file.

volition: volitional processes are included within self-regulation, and deal with an individual's ability to assume responsibility, to perform duties conscientiously, and to predict success. Volition helps learners control cognition and motivation. Volition is thought to be trainable.

Web page: describes a hypertext file transmitted from server to client using the Web.

Web site: server that serves the Web. Usually indicates a net location from which a substantial amount of related information is served.

Web, World Wide Web WWW: a scheme for using the Internet to exchange information in hypermedia formats.

Webify, webified: to make material ready for delivery over the Web.

weblet: a complete, self-contained subset of hypertext linked materials available from a single source other than the Internet. Weblets are constructed by persons for whom access must be assured, and for whom the full power of the Web is not essential. While weblets provide access and security, they defeat one of the Web's main objectives, namely, unrestricted, worldwide hypertext linkage.

Web-teaching: instruction or training conducted using the Web.

whiteboard: shared screen in which two (or more) parties can discuss a document and independently mark the same document.

wrap: lines that start a new line when they texts comes to the end of the screen. Without wrap, the right side of long lines can be invisible off the screen.

WYSIWYG: (pronounced WIZ-ee-wig) software which provides a “what you see is what you get” medium for producing HTML text. Whatever appears on the design screen will appear the same when viewed.

# URLs

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U01.03. Ted Nelson, http://www.sfc.keio.ac.jp/~ted/ (accessed 3/30/00).
U02.01. Monarch Watch, http://www.MonarchWatch.org/ (accessed 4/9/00).
U02.02. Journey North, http://www.learner.org/jnorth/ (accessed 7/15/00).
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U02.04. Cabri Geometry II™, http://www.ti.com/calc/docs/cabri.htm (accessed 7/16/00).
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